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RESEARCH ARTICLE

POLYHERBAL APPROACHES IN THE MANAGEMENT OF HYPERTENSION: A REVIEW ON SYNERGISTIC EFFECTS OF MEDICINAL PLANTS

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Abstract

High blood pressure is a significant health issue worldwide and a primary risk factor for cardiovascular conditions like stroke, heart attack, and heart failure. Despite the availability of various synthetic antihypertensive drugs, their long-term use is often associated with adverse effects and poor patient compliance. This has led to growing interest in herbal and polyherbal therapies as safer and more effective alternatives. Polyherbal formulations, comprising multiple medicinal plants, can improve therapeutic effects through synergistic interactions. This review examines the antihypertensive properties of medicinal plants such as *Terminalia arjuna*, *Tribulus terrestris*, *Allium sativum*, and *Moringa oleifera*. These plants contain bioactive phytochemicals such as flavonoids, saponins, tannins, alkaloids, and organosulfur compounds that help lower blood pressure through mechanisms including vasodilation, antioxidant effects, diuretic activity, and inhibition of the renin-angiotensin-aldosterone system. Synergism in polyherbal formulations enables a multi-target approach, improving efficacy while reducing toxicity. Although promising, polyherbal formulations still face challenges, including a lack of standardization and limited clinical evidence. Further research and clinical validation are essential to establish polyherbal formulations as effective therapeutic options for hypertension management.

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Introduction:-

Hypertension is a chronic cardiovascular condition characterized by persistently elevated blood pressure and is one of the leading causes of morbidity and premature mortality worldwide. It is a major risk factor for serious complications, including stroke, myocardial infarction, heart failure, and kidney disease. According to the World Health Organization (WHO), an estimated 1.4 billion adults aged 30-79 years worldwide were living with hypertension in 2025. A substantial proportion of these individuals remain undiagnosed or inadequately treated, particularly in low- and middle-income countries [1]. The pathogenesis of hypertension is complex and involves multiple physiological mechanisms, including overactivation of the renin-angiotensin-aldosterone system (RAAS), increased sympathetic nervous system activity, endothelial dysfunction, and oxidative stress [2, 3]. These factors

increase peripheral vascular resistance, promote vascular remodeling, and reduce vasodilation, resulting in sustained high blood pressure. Widely used to treat hypertension, conventional antihypertensive medications include angiotensin-converting enzyme (ACE) inhibitors, beta-blockers, calcium channel blockers, and diuretics [3]. Although these medications are effective in controlling blood pressure, their long-term use is often associated with adverse effects such as dizziness, fatigue, electrolyte imbalance, and reduced patient compliance. Additionally, monotherapy may not be sufficient for effective management due to the multifactorial nature of the disease [4]. Recently, interest in herbal medicine as an alternative or complementary method for managing hypertension has increased. Medicinal plants contain bioactive compounds such as flavonoids, alkaloids, tannins, and saponins. These substances can help lower blood pressure through vasodilation, diuretic effects, antioxidant properties, and RAAS system inhibition [5, 6]. Much research has been dedicated to plants like *Terminalia arjuna*, *Tribulus terrestris*, *Allium sativum*, and *Moringa oleifera* for their heart-protective and antihypertensive qualities [6-9].

The concept of polyherbal, which involves the use of multiple medicinal plants in combination, is a fundamental principle of traditional systems of medicine such as Ayurveda. Polyherbal formulations are believed to produce synergistic effects, where the combined action of different plant constituents enhances therapeutic efficacy while minimizing toxicity [10]. This approach is particularly beneficial in the management of complex diseases like hypertension, where multiple pathways are involved. Therefore, the present review aims to explore the role of polyherbal formulations in the management of hypertension, with a focus on the synergistic effects, mechanisms of action, and therapeutic potential of selected medicinal plants.

Pathophysiology of Hypertension:

Hypertension is a complex and multifactorial disorder involving the interaction of genetic, environmental, and physiological factors that regulate blood pressure. The development and progression of hypertension are primarily associated with disturbances in vascular function, neurohormonal systems, and renal regulation [11]. One of the most important mechanisms involved in hypertension is the overactivation of the renin-angiotensin-aldosterone system (RAAS). Renin, released from the kidneys, converts angiotensinogen into angiotensin I, which is further converted into angiotensin II by angiotensin-converting enzyme (ACE). Angiotensin II is a potent vasoconstrictor that increases peripheral resistance and stimulates aldosterone secretion, leading to sodium and water retention, thereby elevating blood pressure [12].

Endothelial dysfunction also plays a critical role in the pathogenesis of hypertension. The endothelium regulates vascular tone by releasing vasodilators such as nitric oxide. Hypertension leads to a decrease in nitric oxide availability and a rise in vasoconstrictors like endothelin, which together cause reduced vasodilation and greater vascular resistance [13]. Another important cause of hypertension is oxidative stress. This condition occurs when there is an unequal balance between reactive oxygen species and the body's antioxidant defences. Excess reactive oxygen species leads to vascular damage, inflammation, and further reduction in nitric oxide availability, thereby promoting vasoconstriction and hypertension [14].

Additionally, the sympathetic nervous system plays a major role in the development of hypertension. Elevated sympathetic activity raises cardiac output, heart rate, and vasoconstriction, all of which raise blood pressure [15]. Renal mechanisms are equally important in regulating blood pressure. The kidneys control fluid balance and sodium excretion. Impaired renal function can lead to sodium retention and increased blood volume, which in turn raises blood pressure. Additionally, abnormalities in pressure natriuresis further contribute to sustained hypertension [16]. Furthermore, vascular remodelling, characterised by structural changes in blood vessel walls such as thickening and reduced elasticity, contributes to increased peripheral resistance and sustained hypertension. Thus, hypertension results from the combined effects of neurohormonal activation, endothelial dysfunction, oxidative stress, and renal impairment, making it a complex condition that requires multi-targeted therapeutic approaches [17].

Medicinal Plants with Antihypertensive Activity:

Traditional medicine has relied on medicinal plants to help prevent and manage high blood pressure. These plants contain flavonoids, alkaloids, tannins, and saponins that reduce blood pressure. Their actions include widening blood vessels, increasing urine production, acting as antioxidants, and affecting the renin-angiotensin-aldosterone system (RAAS). Many people consider medicinal plants to be a safer, cost-effective, and more suitable option for prolonged treatment compared to synthetic medications [18,19].

Terminalia arjuna(commonnames: Arjuna, Arjun tree, Kahu)



Fig. 1: Arjuna Tree and Bark

Terminalia arjuna, commonly known as Arjuna, is a well-known medicinal plant widely used in Ayurveda for the treatment of cardiovascular disorders. This plant is part of the Combretaceae family and grows in India as well as various regions of Southeast Asia. The plant's bark, which is rich in bioactive substances such as flavonoids, tannins, triterpenoids, glycosides, saponins, and minerals, is its most useful component for medicinal purposes. These phytoconstituents have antihypertensive, antioxidant, and cardioprotective properties [20].

Table 1: Taxonomic classification of *Terminalia arjuna*

Taxonomic Class	Classification
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Myrtales
Family	Combretaceae
Genus	<i>Terminalia</i>
Species	<i>Terminalia arjuna</i>

Table 2: Phytochemical constituents of *Terminalia arjuna*

Phytochemical Class	Constituents
Flavonoids	Arjunone, arjunolone, luteolin, quercetin
Tannins	Punicalagin, castalagin, terflavin
Triterpenoids	Arjunic acid, arjunolic acid, arjunetin
Glycosides	Arjunoside I, Arjunoside II, terminoside A

Saponins	Triterpenoid, arjunglycosides
Minerals	Calcium, magnesium, zinc, copper

These constituents contribute to its antioxidant, cardioprotective, and antihypertensive properties [20,21].

Pharmacological Actions of Terminalia arjuna:

Cardioprotective Activity:

Terminalia arjuna is widely known for its strong cardioprotective effect, helping to improve myocardial function, strengthen heart muscles, and protect against ischemic damage due to the presence of triterpenoids like arjunolic acid.

Antihypertensive Activity:

It helps lower blood pressure by inducing vasodilation and improving endothelial function; flavonoids and tannins play a significant role in relaxing blood vessels.

Antioxidant Activity:

Rich in polyphenols and flavonoids, it serves as a potent antioxidant, scavenging free radicals and lowering oxidative stress, which is a key cause of cardiovascular illnesses.

Hypolipidemic Effect:

Arjuna helps in lowering cholesterol and triglyceride levels, thus preventing atherosclerosis and improving lipid profile.

Anti-inflammatory Activity:

It exhibits anti-inflammatory effects by inhibiting inflammatory mediators, thereby reducing inflammation in cardiovascular and other tissues.

Mechanism of Action:

The antihypertensive activity of Terminalia arjuna is mediated through multiple mechanisms:

- Enhancement of nitric oxide (NO) release → vasodilation
- Inhibition of lipid peroxidation → protects blood vessels.
- Calcium channel blocking activity → reduces vascular contraction.
- Antioxidant action → improves endothelial function.

These combined effects help in reducing blood pressure and improving cardiovascular health [21,22].

Pharmacological Studies:

Several experimental and clinical studies have demonstrated the effectiveness of Terminalia arjuna:

- Reduction in systolic and diastolic blood pressure
- Improvement in cardiac output
- Reduction in oxidative stress markers

Clinical studies have shown significant improvement in patients with hypertension and ischemic heart disease after administration of Arjuna bark extract [20,22].

Tribulus terrestris (common names: Gokhru, Gokshura, Puncture Vine)



Fig.2: Gokhru Plant and Fruits

Tribulus terrestris, commonly known as Gokhru, is a significant medicinal plant used in ancient medical systems like Ayurveda to treat cardiovascular, reproductive, and urinary diseases. It is extensively distributed in tropical and subtropical regions and is a member of the Zygophyllaceae family. The plant's fruits and aerial parts are used medicinally, particularly for their diuretic and antihypertensive properties[23].

Table 3: Taxonomic classification of *Tribulus terrestris*

Taxonomic Class	Classification
Kingdom	Plantae
Division	Tracheophyta
Class	Equisetopsida
Order	Zygophyllales
Family	Zygophyllaceae
Genus	<i>Tribulus</i>
Species	<i>Tribulus terrestris</i>

Table 4: Phytochemical constituents of *Tribulus terrestris*

Phytochemical Class	Constituents
Alkaloids	Harmane, harmine, norharmane
Flavonoids	Kaempferol, quercetin, rutin
Tannins	Hydrolysable tannins
Triterpenoids	Triterpenes
Glycosides	Steroidal glycosides, furostanol glycosides
Saponins	Protodioscin, prototribestin, dioscin, tribulosin
Phenolic compounds	Caffeic acid, Ferulic acid

These phytoconstituents contribute to its diuretic, antihypertensive, and antioxidant activities [23,24].

Pharmacological Actions of Tribulus terrestris:**Antihypertensive Activity:**

Tribulus terrestris exhibits significant antihypertensive effects primarily due to its rich content of steroidal saponins such as protodioscin, which promote vasodilation by enhancing nitric oxide release from endothelial cells, thereby reducing peripheral vascular resistance and lowering blood pressure.

Diuretic Activity:

The plant acts as a natural diuretic by increasing urine output, facilitating the excretion of excess sodium and water, which contributes to blood pressure reduction and supports kidney function.

Cardioprotective Activity:

It protects cardiac tissues by reducing oxidative stress, improving coronary circulation, and stabilizing heart muscle function, thereby helping in the prevention of ischemic heart conditions.

Antioxidant Activity:

The presence of flavonoids and phenolic compounds such as quercetin and rutin helps in scavenging free radicals, reducing oxidative damage, and preventing cellular injury.

Hypolipidemic Activity:

Tribulus terrestris helps in lowering serum cholesterol, triglycerides, and LDL levels while increasing HDL levels, thus reducing the risk of atherosclerosis.

Mechanism of Action:

- Diuretic action: lowers cardiac output and plasma volume.
- Vascular resistance is reduced by smooth muscle relaxation.
- Vasodilation is improved by nitric oxide modulation.
- Endothelial function is protected by the antioxidant action.

Together, these systems help in the efficient control of blood pressure[24,25].

Pharmacological Studies:

- Both the systolic and diastolic blood pressure significantly decrease.
- Better electrolyte balance and renal function
- A decrease in indicators of oxidative stress

Animal studies have demonstrated that Tribulus terrestris extract produces a notable hypotensive effect, supporting its traditional use [23, 25].

Allium sativum (common names:Garlic, Lahsun, Poondu)

Fig. 3: Garlic Plant and Bulb

Allium sativum, commonly known as garlic, is one of the most extensively studied medicinal plants with significant therapeutic potential in cardiovascular diseases, including hypertension. It belongs to the family Amaryllidaceae and has been used for centuries in traditional medicine systems worldwide. Garlic is well known for its antihypertensive, hypolipidemic, antioxidant, and cardioprotective properties. The therapeutic effects of garlic are attributed to sulfur-containing compounds such as allicin [26].

Tablet 5: Taxonomic classification of *Allium sativum*

Taxonomic Class	Classification
Kingdom	Plantae
Division	Tracheophyta
Class	Liliopsida
Order	Asparagales
Family	Amaryllidaceae
Genus	<i>Allium</i>
Species	<i>Allium sativum</i>

Table 6: Phytochemical constituents of *Allium sativum*

Phytochemical Class	Constituents
Flavonoids	Quercetin, kaempferol
Vitamins	Vitamin C, Vitamin B6
Amino acids	Cysteine, methionine
Saponins	Diosgenin, gitogenin
Minerals	Selenium, calcium, phosphorus, potassium
Organosulfur compounds	Allicin, alliin, ajoene, diallyl sulfide, diallyl disulfide

Among these, allicin is the most active compound responsible for antihypertensive effects [26,27].

Pharmacological Actions of *Allium sativum*:

Antihypertensive Activity:

Garlic lowers blood pressure through vasodilation by increasing the synthesis of nitric oxide (NO) and inhibiting the angiotensin-converting enzyme (ACE). It helps manage hypertension because it relaxes vascular smooth muscles and lowers peripheral resistance.

Antihyperlipidemic Activity:

It lowers total cholesterol, LDL, and triglycerides while increasing HDL levels. Garlic inhibits hepatic cholesterol synthesis and enhances lipid metabolism, thus preventing atherosclerosis.

Cardioprotective Activity:

Garlic protects the heart by improving lipid profile, reducing blood pressure, preventing plaque formation, and enhancing endothelial function.

Antioxidant Activity:

Rich in sulfur compounds and flavonoids, garlic scavenges free radicals, reduces oxidative stress, and protects cells from damage. This contributes to cardiovascular protection and anti-ageing effects.

Antiplatelet and Antithrombotic Activity:

Garlic inhibits platelet aggregation by suppressing thromboxane formation and enhancing fibrinolytic activity, thereby reducing the risk of thrombosis and cardiovascular diseases.

Mechanism of Action:

- Vasodilation by the release of nitric oxide (NO)
- Angiotensin-converting enzyme (ACE) inhibition
- The synthesis of hydrogen sulfide (H₂S) relaxes vascular smooth muscles.
- A decrease in oxidative stress

These mechanisms collectively contribute to lowering blood pressure and improving cardiovascular health [27,28].

Pharmacological Studies:

- Significant reduction in systolic and diastolic blood pressure
- Improvement in lipid profile
- Reduction in cardiovascular risk factors

Clinical studies have demonstrated that taking garlic supplements can lower blood pressure in some patients to a degree like standard antihypertensive medications [28].

Moringa oleifera (commonnames: Drumstick tree, Sahjan, Miracle)



Fig.4: Moringa Tree and Leaves

Moringa oleifera, also referred to as drumstick tree or “Miracle Tree,” is a highly valued medicinal plant widely used in traditional medicine for the treatment of various diseases, including hypertension. It belongs to the family Moringaceae and is native to India. While the plant's leaves are particularly valued for their therapeutic properties, all parts of the plant have therapeutic effects. The antihypertensive, antioxidant, and anti-inflammatory properties of moringa are attributed to its abundance of vital minerals and bioactive substances[29].

Table 7: Taxonomic classification of *Moringa oleifera*

Taxonomic Class	Classification
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Brassicales
Family	Moringaceae

Genus	<i>Moringa</i>
Species	<i>Moringa oleifera</i>

Table 8: Phytochemical constituents of *Moringa oleifera*

Phytochemical Class	Constituents
Alkaloids	Moringine, moringinine
Flavonoids	Quercetin, kaempferol, rutin
Tannins	Condensed tannins
Phenolic Compound	Chlorogenic acid, caffeic acid, gallic acid
Glycosides	Cardiac glycosides, thiocarbamate glycosides
Vitamins	Vitamin A, Vitamin C, Vitamin E
Minerals	Calcium, potassium, iron, magnesium

Among these, quercetin plays a significant role in blood pressure reduction due to its vasodilatory properties [29,30].

Pharmacological Actions of *Moringa oleifera*:

Antihypertensive Activity:

Moringa helps reduce blood pressure due to the presence of bioactive compounds like nitrile, thiocarbamate, and isothiocyanate glycosides, which function as vasodilators and improve blood circulation.

Antioxidant Activity:

It is rich in antioxidants such as quercetin, chlorogenic acid, and vitamin C, which neutralise free radicals and protect cells from oxidative stress.

Cardioprotective Activity:

Moringa protects the heart by reducing lipid levels, preventing plaque formation, and improving overall cardiovascular function.

Diuretic Activity:

It increases urine output, helping in the elimination of excess salts and fluids, which is beneficial in hypertension.

Antimicrobial Activity:

It shows activity against bacteria, fungi, and some viruses due to the presence of compounds like pterygospermin and benzyl isothiocyanate.

Mechanism of Action:

- Vasodilation via nitric oxide (NO) pathway
- Calcium channel blocking activity
- Reduction of oxidative stress
- Diuretic effect (mild)

These mechanisms help in reducing peripheral resistance and improving blood flow, thereby lowering blood pressure [30,31].

Pharmacological Studies:

- Significant decreases in both the diastolic and systolic blood pressure
- An increase in the amounts of antioxidant enzymes
- Protection against cardiovascular disorders

Animal studies and preliminary human studies support the antihypertensive potential of *Moringa oleifera* [29, 31].

Synergistic Mechanisms of Polyherbal Formulations:

Polyherbal formulations are based on the principle that the combination of multiple medicinal plants can produce enhanced therapeutic effects compared to single-drug therapy. This phenomenon is known as synergism, where the combined action of different phytoconstituents results in improved efficacy and reduced toxicity [32]. In the management of hypertension, polyherbal formulations are particularly helpful because the disease involves multiple pathophysiological pathways such as oxidative stress, endothelial dysfunction, overactivation of the renin-angiotensin-aldosterone system (RAAS), and increased sympathetic activity. A single drug may not effectively target all these mechanisms, while a combination of herbal agents can act on multiple targets simultaneously [33].

Mechanisms of Synergistic Action:

Multi-target Action:

Different plant constituents influence various physiological pathways, including vasodilation, increased urine production (diuresis), antioxidant activity, and inhibition of angiotensin-converting enzyme (ACE). These combined mechanisms may contribute to better blood pressure regulation [34].

Pharmacodynamic Synergism:

Pharmacodynamic synergism occurs when two or more herbs produce similar therapeutic effects, resulting in an enhanced overall response. Garlic helps promote vasodilation, while *Moringa* provides antioxidant effects and also supports vasodilation. Together, these actions may improve their overall effectiveness in reducing blood pressure.

Pharmacokinetic Synergism:

One plant may enhance the absorption, distribution, or bioavailability of another, improving overall effectiveness [35].

Reduction of Toxicity:

Certain herbs reduce the side effects of others, improving safety and tolerability in long-term use [32].

Synergistic Effects of Medicinal Plants:

The combination of *Terminalia arjuna*, *Tribulus terrestris*, *Allium sativum*, and *Moringa oleifera* provides a comprehensive antihypertensive effect:

Table 9: Synergistic effects of medicinal plants

Plant	Action
<i>Terminalia arjuna</i>	Cardioprotective, antioxidant effects
<i>Tribulus terrestris</i>	Diuretic action
<i>Allium sativum</i>	ACE inhibition & vasodilation
<i>Moringa oleifera</i>	Antioxidant & vascular protection

These medicinal plants may provide several beneficial effects, including reducing vascular resistance, improving cardiac function, maintaining fluid balance, and decreasing oxidative stress. This combined approach may offer better therapeutic outcomes than the use of a single treatment alone [33,34].

Advantages of Polyherbal Synergism:

- Enhanced therapeutic effectiveness
- Reduced dosage requirements for individual medications
- Diminished incidence of adverse effects
- Increased patient adherence to treatment
- Improved management of chronic conditions such as hypertension [32,35]

Challenges in Polyherbal Formulations:

- Lack of standardization
- Variability in phytochemical composition
- Difficulty in identifying active components
- Limited clinical validation [33]

Phytochemical Basis of Antihypertensive Activity:

Medicinal plants help in lowering blood pressure due to a variety of bioactive phytochemicals. These compounds influence neurohormonal pathways that are crucial for blood pressure regulation, enlarge blood vessels, function as antioxidants, and encourage diuresis[36].

Table 10: Phytochemical Basis of Antihypertensive Activity

S. No.	Phytochemical Class	Examples	Mechanism of Action	Antihypertensive Effect	References
1	Flavonoids	Quercetin, Kaempferol	Increases nitric oxide (NO) production and antioxidant activity	Vasodilation, lower vascular resistance	[36,37]
2	Alkaloids	Reserpine (plant alkaloid)	Acts on the CNS and reduces sympathetic activity	Lowers heart rate and blood pressure	[36]
3	Saponins	Protodioscin	Diuretic action, increases sodium excretion	Lower blood volume and blood pressure	[38]
4	Tannins	Ellagic acid	Antioxidant, vascular protection	Improves endothelial function	[37]
5	Phenolic compounds	Chlorogenic acid	Reduces oxidative stress	Improves vascular elasticity	[36]
6	Organosulfur compounds	Allicin (Garlic)	ACE inhibition, NO release	Vasodilation, lower blood pressure	[26,27]
7	Terpenoids	Arjunolic acid	Cardioprotective, antioxidant	Improves cardiac function	[20,21]
8	Glycosides	Cardiac glycosides	Improves myocardial contractility	Supports heart function	[20]

Advantages of Polyherbal Therapy:

- Polyherbal therapy provides a multi-target approach, acting on different physiological pathways involved in hypertension.
- It shows enhanced therapeutic efficacy due to the synergistic interaction of multiple plant constituents.
- It requires lower doses of individual herbs, which helps in minimizing toxicity.
- It has reduced side effects compared to synthetic antihypertensive drugs.
- It is safe for long-term use in chronic conditions like hypertension.
- It is cost-effective and affordable for a large population.
- It improves patient compliance due to fewer adverse effects and its natural origin.
- It provides antioxidant, anti-inflammatory, and cardioprotective effects simultaneously.
- It helps in better management of comorbid conditions such as hyperlipidemia and cardiovascular disorders.
- It uses natural and easily available resources, especially in traditional medicine systems.
- It can enhance the bioavailability of active constituents through synergistic interactions. [39].

Limitations of Polyherbal Formulations:

Polyherbal formulations lack standardized composition and dosage.
Phytochemical content varies by plant source, season, and processing.
Quality control challenges hinder batch consistency.

Clinical evidence is insufficient; few large-scale trials exist.
Herb-drug interactions are possible.
Identifying active constituents is complex due to multiple ingredients.
Dose optimization is difficult for multi-herb blends.
Risks include adulteration and contamination (heavy metals, pesticides, microbes).
Stability and shelf-life concerns may reduce efficacy.
Limited scientific evidence supports their mechanisms [40].

Few Reviews:

Jaisal et al. (2025) reviewed the role of *Terminalia arjuna* and hawthorn in cardiovascular health. They noted the flavonoids, tannins, and triterpenes of Arjuna and discussed its cardioprotective effects. *T. arjuna*, the review suggested, may improve cardiovascular function, regulate lipids, and help control blood pressure, which makes it a promising herbal candidate for hypertension and related disorders.

Tahir et al. (2025) reviewed the nutritional make-up, phytochemistry, extraction methods, and health benefits of *Terminalia arjuna* bark. The bark holds important bioactives such as polyphenols, flavonoids, tannins, and triterpenoids, including gallic, ellagic, arjunolic, and arjunic acids. These were linked with antioxidant, cardioprotective, hypolipidaemic, and possible hypotensive effects, and the authors highlighted the bark's value in cardiovascular disorders, supporting its use in antihypertensive herbal products.

Menichetti et al. (2025) reviewed the evidence on *Moringa oleifera* and blood pressure. Looking at animal and human studies on different parts of the plant, they found the leaves the most promising. ACE inhibition, better endothelial function, antioxidant activity, and vasodilation were put forward as possible mechanisms. High-quality randomized clinical trials are still few, though, so more work is needed.

Ma X et al. (2025) carried out an updated meta-analysis of garlic in hypertension, covering 12 clinical trials and 738 participants. Garlic lowered both systolic and diastolic blood pressure significantly. Trial sequential analysis and GRADE assessment showed the evidence to be strong and reliable. The authors suggest garlic extract is an effective natural supplement that can safely be recommended as supportive therapy for high blood pressure.

Kiran et al. (2025) reviewed the diuretic activity of *Tribulus terrestris* in depth. Across preclinical and clinical studies, aqueous and ethanolic extracts of the fruit or whole plant increased urine output and urinary sodium excretion. Such diuretic action could help in conditions involving fluid retention and hypertension, and the review also stressed the role of the plant's phytoconstituents in its activity.

Komal et al. (2025) formulated and evaluated a herbal tablet for managing high blood pressure based on a medicinal plant. The tablets had acceptable physical properties and released the active ingredient in a sustained way.

Poonam et al. (2024) reviewed the traditional uses, phytochemistry, and pharmacology of *Tribulus terrestris*. The plant contains steroidal saponins and flavonoids and has shown cardioprotective, hypolipidaemic, antidiabetic, anti-inflammatory, and other activities. *T. terrestris* may therefore support cardiovascular and antihypertensive therapy, particularly within a polyherbal approach.

Bandar Hamad et al. (2022) noted that about 80% of people in developing countries rely on herbal medicines for basic health care. Natural medicines are preferred because they usually have fewer side effects and are safe, easily accepted, and affordable. Reviewing medicinal plants commonly studied for hypertension, the authors concluded that herbal medicines are useful and promising natural treatments for high blood pressure.

Future Perspectives:

The future of polyherbal formulations in hypertension management appears promising, as advances in research and technology may help overcome existing limitations. Key areas of future development include the standardization of herbal extracts, conducting clinical trials to establish safety and efficacy, developing novel drug delivery systems such as tablets and capsules, integrating herbal formulations with modern medicine, and identifying active phytoconstituents responsible for therapeutic effects. With proper scientific investigation and clinical validation, polyherbal formulations may play an important role in global healthcare.

Conclusion:-

High blood pressure is a complex health condition influenced by multiple factors and requires a comprehensive approach for effective management. While conventional antihypertensive drugs are effective in controlling blood pressure, their long-term use may be associated with side effects and limitations in addressing the multiple mechanisms involved in the development of hypertension. Polyherbal therapy represents a promising approach that combines the therapeutic properties of medicinal plants such as *Terminalia arjuna*, *Tribulus terrestris*, *Allium sativum*, and *Moringa oleifera*. These plants contain various bioactive phytochemicals that may help regulate blood pressure through different mechanisms, including vasodilation, antioxidant activity, diuretic effects, and cardioprotection.

Synergistic interactions among the herbal constituents may improve the overall therapeutic effects of polyherbal formulations. This approach may also help reduce the required dosage and minimize adverse effects. Also, the affordability, availability, and potential tolerability of polyherbal formulations may support patient adherence to long-term treatment. Despite their potential advantages, polyherbal formulations still face several challenges, such as the lack of proper standardization, insufficient clinical evidence, and regulatory issues. These challenges can be overcome through systematic research, effective quality control, and well-designed clinical trials. With adequate standardization, reliable evidence of safety and efficacy, and appropriate integration with conventional medicine, polyherbal formulations may become a valuable complementary option for managing hypertension in the future.

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