Current Pharmaceutical Research (CPR)
Vol 1, Issue 4, October-December 2025
Journal Homepage: https://cpr.org.in/

Review Article

Herbal Approaches for the Treatment of Hypertension: A Literature Review

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Keywords

Hypertension, Herbal drugs, Medicinal plants, Cardiovascular disorders, Alternative therapy, Blood pressure control..

Abstract

Background: High blood pressure is a very common disease in most countries. This can also cause the worsening of other cardiovascular disorders. The total number of people who are suffering from hypertension has elevated in the past thirty years. It impacts the quality of life and it can be caused due to many factors like the lifestyle of the patient (inactivity), stress, obesity, stress, alcohol consumption, unhealthy food habits, age, and other underlying diseases. It is estimated that the cases of hypertension will rise up to 23.25 % by the year 2025 in India. Its occurrence in urban areas is more compared to the rural areas. In order to treat hypertension alternative medication can be used. **Method:** To carry out this review we searched out the articles from various databases which includes PubMed, web of science and google scholar. All the papers that discussed about hypertension and its herbal remedies were screened. **Conclusion:** Thus, the current review aimed to highlight various herbal drugs used for the treatment of hypertension. Many patients prefer herbal remedies over modern drugs. There are many herbal drugs available, which can be used for the successful treatment of high blood pressure like hibiscus, tulsi, garlic, Ashoka and etc..

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Article Info
Received: 09 December 2025; Received in revised form: 16 January 2026; Accepted: 16 January 2026; Available online: 21 January 2026; Volume: 1; Issue: 4; Pages: 498-508.

ISSN: 3049-2955/The authors © 2025, under exclusive license to the Sprout Publication.
DOI: https://doi.org/10.63785/2025.1.4.498508

1. Introduction

Hypertension is a major cause of mortality as well as morbidity in Indian occupants. However, awareness regarding the treatment of hypertension is not high among the population of almost all the countries. It is estimated that about 639 million people are suffering from elevated blood pressure, which is about three fourth of the total number of blood pressure cases [1]. A frequent indication of diseased of heart according to various studies is unexpected death. Even though treatment is accessible as well as efficient, it is usually palliative instead of curative. Due to which, treating and preventing risk factors associated with heart diseases, such as elevated BP is a core strategy to minimize complications of the disease [2]. 140/90 mm Hg is the current therapeutic intervention level in guidelines. As a result, a significant portion of the population is affected. The majority of BP-related health conditions develops at blood pressure levels that are too high which may be regarded as unsatisfactory (systolic blood pressure of 115 to 140 mm Hg) but for which no evidence of the cause exists [3].

The underlying risk factors for hypertension can help explain why some people are more likely than others to develop hypertension. Risk factors might be inherited, behavioural, or environmental, or they can be caused by a medical condition. They can be reversible, irreversible, or associated with additional risk factors [4].

The aetiology and pathophysiology of elevated blood pressure depends upon the incompetence of the kidney to excrete sodium chloride at a regular rate which as a result causes hypertension. Elevated blood pressure is usually caused by combination of factors, which are multidimensional quantitative characteristics impacted by a range of genetic and environmental factors [5].

2. Types of Hypertension

2.1 Essential hypertension

Essential hypertension can be described as an elevation in blood pressure that occurs due to no apparent reason and increases the possibility of the occurrence of cardiac and renal problems. The risk of acquiring hypertensive (high blood pressure) is higher in developed countries. There is 90% chance of occurrence of high blood pressure (>140/90 mm Hg) during the course of a lifetime [5].

Even though it is usually stated that the origin of this type of blood pressure is not known, this is only partially correct, since a very minute amount of information about genetic variants, overexpressed as well as under-expressed genes, as well as the intermediate phenotypes that regulate to cause elevated blood pressure is known. Some of the expected reasons for essential hypertension are the following [6].

Figure 1 Factors affecting hypertension. The figure summarizes the major biological, lifestyle, and dietary factors that contribute to the development and progression of hypertension. Advancing age represents a non-modifiable risk factor that is strongly associated with increased arterial stiffness and elevated blood pressure. Lifestyle-related factors such as low physical activity, excessive alcohol consumption, psychological stress, and high dietary sodium intake contribute to sympathetic overactivity and impaired vascular regulation. Metabolic abnormalities, including adiposity and insulin resistance, further promote hypertension through inflammatory and endocrine mechanisms . Inadequate intake of essential minerals, particularly potassium and calcium, disrupts electrolyte balance and vascular smooth muscle function, thereby increasing blood pressure. Collectively, these interrelated factors act synergistically to influence blood pressure regulation and underscore the multifactorial nature of hypertension [7].

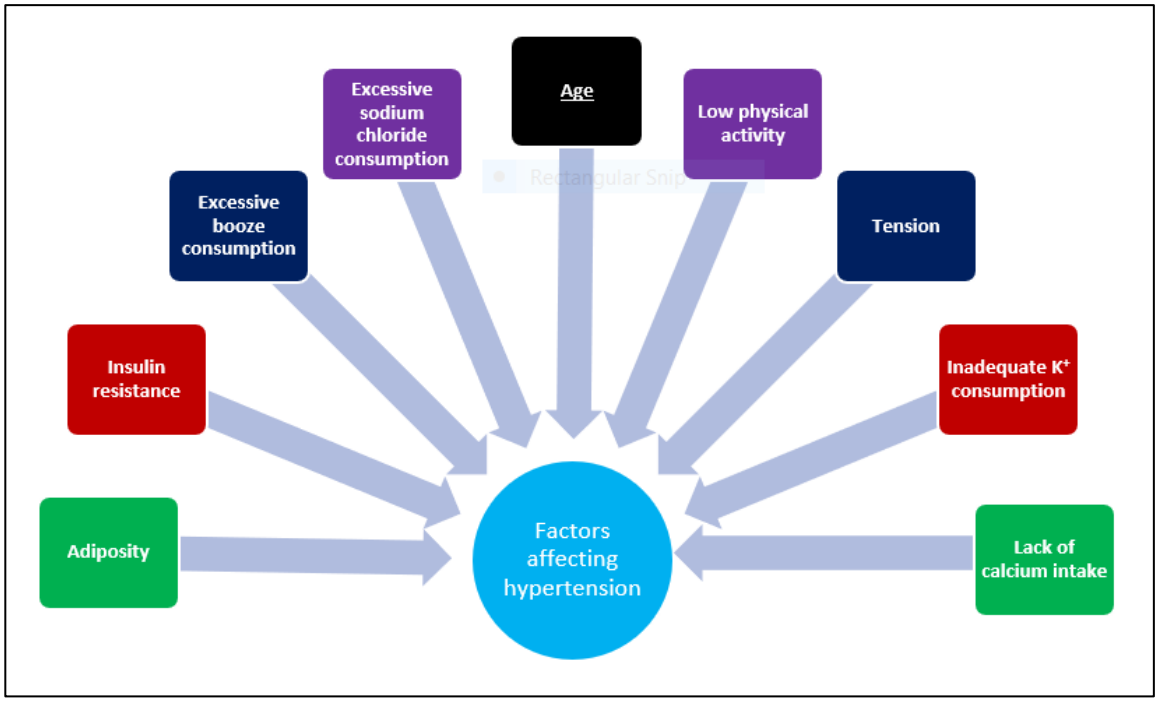

Figure 1: Factors affecting hypertension.

2.2 Secondary hypertension

Secondary hypertension impacts a smaller but significant fraction of patients suffering from elevated blood pressure and, in contrast to primary hypertension, it is a condition that can be treated. Although the majority of patients have essential hypertension with no apparent reason, it is essential to consider secondary causes of high blood pressure, since they might be treatable. Secondary hypertension, if left untreated, can lead to a wide variety of complications, such as cardiovascular and renal consequences. This will result in an undue burden on the healthcare system [8, 9].

The secondary cause of hypertension affects about 10% of the total number of patients. In children and young people, secondary factors such as renal illness or aortic coarctation are frequently considered by clinicians. Furthermore, it's vital to remember that secondary reasons, such as primary aldosteronism, renal illness, and obstructive sleep apnea, are also prevalent in elderly patients. These are found to be more prevalent in people with resistant hypertension, which is described as a BP of less than 140/90 mmHg even after taking three hypotensive medications, including a diuretic. Additional reasons, such as pheochromocytoma, are less prevalent but just as crucial to recognise, as failing to identify and cure them can have disastrous effects [10].

Figure 2 Classification of hypertension based on systolic and diastolic blood pressure measurements. The figure illustrates the standard categories of blood pressure used in clinical practice. Normal blood pressure is defined by a systolic pressure of 120 mm Hg and a diastolic pressure of 80 mm Hg [11]. Prehypertension represents an intermediate stage, characterized by systolic values between 120 and 139

mm Hg and diastolic values between 80 and 89 mm Hg, indicating an increased risk for progression to hypertension. Stage I hypertension is identified by systolic blood pressure ranging from 130 to 159 mm Hg and diastolic pressure between 90 and 99 mm Hg. Stage II hypertension reflects more severe disease, defined by systolic blood pressure of 160 mm Hg or higher and diastolic pressure of 100 mm Hg or higher. This classification aids in risk stratification, clinical decision making, and selection of appropriate therapeutic interventions [12].

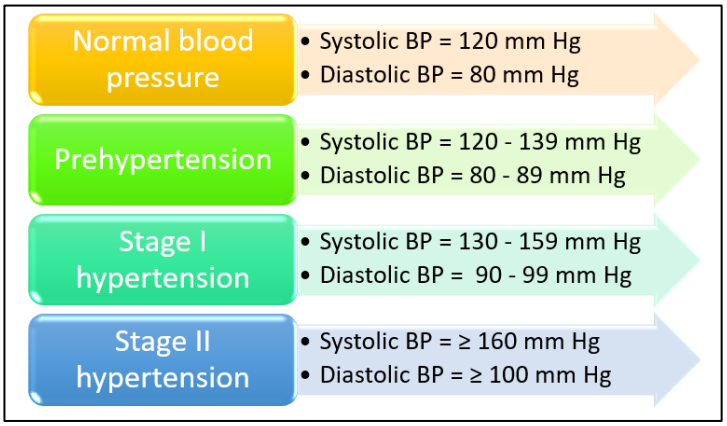

Figure 2: Classification of hypertension based on measurements of systolic as well as diastolic blood pressures.

3. Pathophysiology

Due to various risk factors which include stress, excessive salt intake, obesity, alcohol intake or any underlying disease, these causes changes in the arteriolar bed which resulting in systemic vascular resistance and hence causing elevated blood pressure. Figure 3 Renin angiotensin aldosterone system (RAAS) and its role in the regulation of blood pressure. The figure illustrates the sequential activation of the RAAS pathway initiated by etiological factors that stimulate the release of renin from the juxtaglomerular cells of the kidney. Renin catalyzes the conversion of angiotensinogen to angiotensin I, which is subsequently converted to angiotensin II by angiotensin converting enzyme secreted primarily by the lungs. Angiotensin II acts as a potent vasoconstrictor and also stimulates the secretion of aldosterone. Increased aldosterone levels promote sodium and water retention, leading to an expansion of blood volume. Together, vasoconstriction, increased peripheral resistance, and elevated blood volume contribute to a sustained rise in blood pressure. This pathway plays a central role in the pathogenesis of hypertension and represents a key therapeutic target for antihypertensive drugs [13].

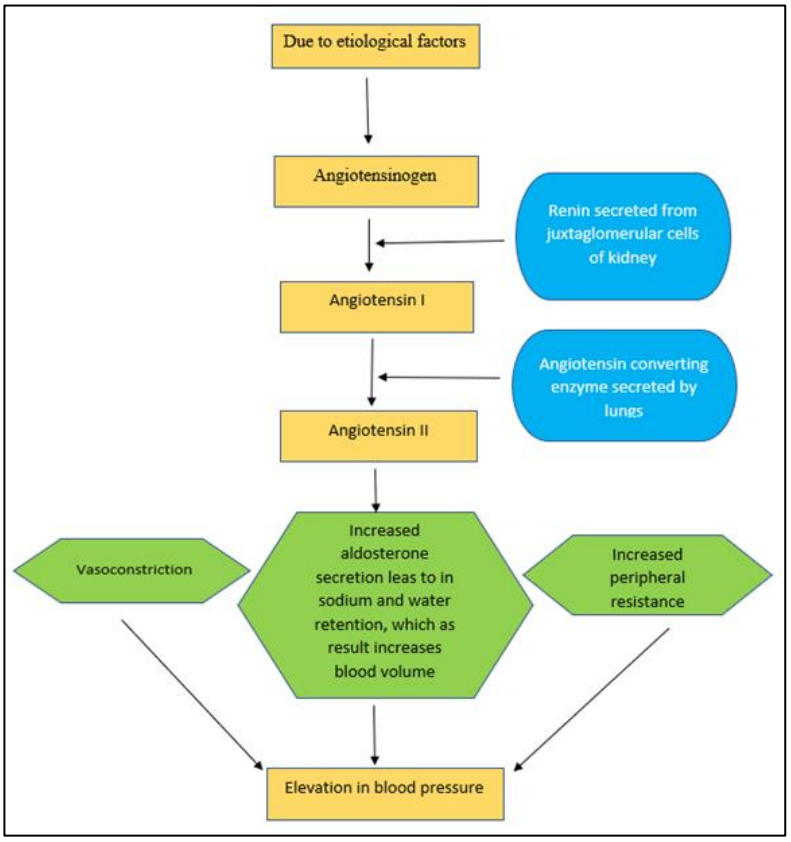

Figure 3: RAAS.

4. Treatment of Hypertension

ACE inhibitors, ABRs, α-blockers, β-blockers, Ca+2 channel blockers, Diuretics, Direct renin inhibitors, and others are used to treat hypertension [14]. Dry cough, dizziness, swollen ankles, fatigue, depression, sleeplessness, infertility, arrhythmias, slow heartbeat, constipation, loss of taste, headache, gout, kidney damage are some of the negative effects of vasodilators (rare). Diuretics can induce muscle cramps, dizziness, excessive weariness, dehydration, impaired vision, an irregular heart rate, skin rash, and other side effects [15]. ACE inhibitor adverse effects include cough, skin rash, nausea, renal failure, fever, sore throat, diarrhoea, and others. Fatigue, headache, diarrhoea, constipation, skin rash, oedema, and other side effects are common with calcium channel blockers. As a result, scientific studies propose a variety of lifestyle adjustments as well as the use of appropriate herbal medicine to treat hypertension [16, 17]. Stress reduction, reduced alcohol intake, regular exercise, limited salt intake, good food, smoking cessation, and the use of appropriate herbals are all included in these diverse lifestyle improvements. Herbs do not produce weakness, exhaustion, drowsiness, impotence, chilly hands and feet, sadness, or other negative side effects [18, 19].

5. Reasons for Using Herbal Alternatives

Several studies support that using selective herbal medicines along with a nutritious diet can help reduce hypertension and improve the overall functioning of the heart, arteries, and cardiovascular system. Natural medicine offers numerous advantages over conventional therapies. Herbal treatments are generally less expensive and widely available, making them accessible to a larger population. Unlike allopathic treatments, herbal medicines are associated with fewer side effects when used as directed, making them relatively safe for regular use to promote general health. These remedies not only help in treating the primary condition but also contribute to the relaxation and rejuvenation of other body systems, supporting overall well-being. Moreover, natural therapies focus on addressing the root cause of a health issue rather than merely alleviating symptoms, leading to more lasting solutions. Their holistic approach aids in revitalizing health while minimizing the risks of adverse reactions, provided the dosage and instructions are carefully followed [20].

6. Herbal Alternative

Traditional treatment of diseases relies on natural derivatives obtained from plants as well as animals. Natural remedies are in high demand right now, and their demand is increasing more and more. There are various herbal remedies that are used to treat high blood pressure, and some of them are given in Table 2 [21].

Table 2: Antihypertensive agents obtained from natural origin.

S. No.	Drug	Part, Biological Source, Family	Dose	Animal Used	Pharmacological Effect	References
1.	Hibiscus	Flowers, leaves, *Hibiscus sabdariffa*, Malvaceae	200 mg/kg of the drug for one month	Rat	Reduction in triglycerides and LDL-C cholesterol. antihypertensive and anti-hyperlipidemic action	[22]
2.	Tulsi	Leaves, *Ocimum sanctum,* Lamiaceae	200 mg/kg drug was administered for 14 days	Swiss albino rat	Cardioprotective activity, hypotensive activity, anti-tussive activity and anti-inflammatory activity.	[23]
3.	Sarpagandha	Roots, *Rouwolfia serpentina,* Apocynaceae	100 mg/kg, 200 mg/kg of drug was administered in experimental group for 4 weeks.	Albino rat	Anti-hypertensive and anti-hyperlipidemic action	[24]
4.	Garlic	Bulb, *Allium sativum*, Alliaceae	50 mg/kg of drug for 4 weeks	Rat	Reduction in blood pressure.	[25]

5.	Gingseng	Root, *Panex ginseng,* Araliaceae	50, 100 and 500 mg/kg of drug extract for 4 weeks.	Rat	Reduction in blood pressure.	[26]
6.	Ashoka	Bark, root, *Polyalthia longifolia*, Annonaceae.	180 mg/kg of leaf extract of drug, twice for 24 hrs.	Rat	Increases hypoglycaemic action, decreases blood pressure.	[27]
7.	St. Johns wort	Leaves, *Hypericum perforatum*, hypericaceae	100 mg/kg, 200 mg/kg of drug for 15 consecutive days	Rat	Decrease in cholesterol	[28]
8.	Mistletoe	Leaves, *Viscum album*, Viscaceae	150 mg/kg of drug extract was administered for 6 weeks	Rat	Decrease in blood presser (anti-hypertensive activity)	[29]
9.	African mistletoe	Leaves, bark *Loranthus micranthus*, lorantheaceae	250 mg/kg of leaf extract of drug was administered for 21 days	Albino mice	Inhibit increased serum nitric acid and lipid. Produces anti-hypertensive activiy, causes vasorelaxation.	[29]
10.	Stinging nettle	Leaves, cortex, rhizomes, *Urtica dioica,* Urticaceae	Dose of 10, 50 and 200 mg/kg of drug for 4 weeks.	Rat	Enhancement in cardiac performance, decrease blood pressure, elevation in antioxidant capacity of plasma.	[30]
11.	Bhingaraj	Leaves, *Eclipta alba*, Asteraceae	250 and 500 mg/kg of drug extract for 10 days.	Adult wistar albino rat	Produces hypotensive as well as hypocholesterolemic properties.	[31]
12.	Ashwagandha	Roots, *Withania somnifera*, Solanaceae	50 and 100 mg/kg of drug was administered for 35 days	Rat	Decrease in blood pressure, cardioprotective, anti-inflammatory and antioxidant activity	[32]
13.	Hogweed	Whole plant, *Boerhavia diffusa*, Nyctaginaceae	500 mg/kg of drug extract was administered for 90 days.	Dog	Reduction in both systolic as well as diastolic blood pressure.	[33]
14.	Arjuna	Bark, *Terminalia arjuna,* Combretaceae	125 and 250 mg/kg of the drug were administered in the experimental group for 25 days.	Male Wistar rat	Decrease in pulmonary hypertension.	[34]
15.	Black cumin	Seeds, *Nigella sativa,* Ranunculaceae	2.5 mg/kg of the drug was given for 8 days.	Sprague-Dawley rat	Reduction in blood pressure due to decrease in ACE and cardiac oxidative stress.	[35]
16.	Satawari	Dried root, *Asperagus recemosus,* Asperagaceae	100 and 250 mg/kg of the drug for 4 weeks	Wistar rat	Prevention of hyperglycaemia	[36]

17.	Alpinia	Leaves, *Alpinia zerumbet*, Zingibaraeceae	300 mg/kg of drug extract for 30 days.	Rat	Cardioprotective in nature.	[37]
18.	Ephedra	Stem, *Ephedra sinica*, Ephedraceae	610 mg/kg of drug extract for 4 weeks.	Mice	Improved metabolism of lipid, reduction on blood pressure	[38]
19.	Angelica	Dried root, *Angelica gigas*, Apiaceae	100 mg/kg of drug for duration of 24 hours	Rat	Relaxation of endothelium and effectively reduces high blood pressure.	[39]
20.	Chuan Xiong	Root, *Ligusticum wallichii*, Apiaceae	30 or 50 mg/kg of drug for every 12 hr for 8 days	Rat	Decrease in blood pressure.	[40]
21.	Forskolin	Roots, *Coleus forskohii*, Lamiaceae	85 mg/kg of drug in rats for 2 days	Rat	Reduction in atherogenic index produces cardioprotective activity and anti-atherogenic activity.	[41]
22.	Resins	Seed extract, *Vitis vinifera*, Vitaceae.	200 mg/kg of drug daily for 12 weeks.	Wistar rat	Decrease in systolic blood pressure, normalised triglyceride and cholesterol level.	[42]
23.	Olive	Leaves, *Olea africana*, Oleaceae	60 mg/kg of drug extract was administered for 6 weeks.	Rat	Increase in insulin resistance, decrease in blood pressure, and prevention of occurrence of atherosclerosis.	[43]
24.	Yarrow	Dried arial parts, *Achillea millefolium*, Asteraceae	100 – 300 mg/kg of drug was administered for 12 hours.	Rat	Hypotensive effect, decreases angiotensin II production.	[44]
25.	Lotus	All parts, *Nelumbo nucifera*, Nymphaeaceae	40 mg/kg of neferine extracted from Nelumbo nucifera for 4 weeks.	Rat	Vasorelaxation due to endothelium nitric oxide synthase production in hypotensive activity.	[45]
26.	Ginger	Dried roots, rhizomes, *Gingiber officinale*, Zingiberaceae	200 mg/kg of drug for 15 days.	Albino rat	Reduction in cardiotoxicity, decrease in systolic and diastolic blood pressure.	[46]
27.	Ginkgo	Leaf, seed, *Ginkgo biloba*, Ginkgoaceae	60, 90 and 180 mg/kg of drug extract for 3 weeks.	Rat	Decrease in blood pressure.	[47]
28.	Poppy	Capsules, *Papaver somniferum*, Papaveraceae	5, 10, 15 and 35 mg/kg of drug.	Rat	Increase in sleep time duration, produces anti-hypertensive action	[48]
29.	Indian Grass	Leaf, seed, *Tropaeolum majus*. Family, Tropaeolaceae	25 – 100 mg/kg of powdered drug extract for 7 days.	Rat	Produced diuretic effect.	[49]
30.	Bhuiaonla	Fruit, leaves, *Phyllanthus urinaria*, Euphorbiaceae	5 mg/kg of drug was admnistered. Blood pressure was measured for 24 hours.	Rat	Produced anti-oxidant activity.	[50]

31.	Coriander	Seeds, *Coriandrum sativam*,	40 and 100 mg/kg doses of aqueous	Wistar rat	Increase in glomerular filtration, increase in	[51]

		Umbelliferae	extract of drug was given by continuous infusion for 120 minutes.		diuresis as well as electrolyte excretion.	
32.	Garden cress (Chandrasur)	Leaves, root, seeds, *Lepidium sativum*, Brassicaceae	20 mg/kg of drug extract for 3 weeks	Rat	Decrease in blood pressure, produces diuresis.	[52]
33.	Laelia	Roots, *Laelia anceps*, Orchidaceae	100 mg/kg of drug extract was administered. Blood pressure as measured at 6 hours.	Rat	Produces vasorelaxation and anti-hypertensive activity.	[53]
34.	Vanilla	Seeds, *Mesona procumbens*, Mesona	250 mg/kg of drug for 4 weeks.	Rat	Anti-hypertensive, hepatoprotective agent	[54]
35.	Mexican Giant Hyssop	Bark, *Agastache mexicana*, Lamiaceae	50 mg/kg of drug was administered BP was measured At 0, 1, 2, 4 and 6 hr.	Rat	Decrease in systolic as well as diastolic blood pressure.	[55]
36.	Tea	Dried leaves, *Camilla sinensis*, Theaceae.	20 mg/kg of drug extract was administered for 2 weeks.	Rat	Anti-oxidant property, hypotensive property.	[56]
37.	Beetroot	Root, *Beta vulgaris*, Chenopodiaceae	100 and 300 mg/kg of drug for 14 days.	Rat	Produced anti-hypertensive activity.	[57]
38.	Lemongrass	Aerial parts, *Cymbopogon proximus*, Poaceae	100 mg/kg of drug for 2 weeks.	Rat	Decreases blood pressure.	[58]
39.	Saffron	Stigma, *Crocus sativus*, Iridaceae.	10, 20 and 40 mg/kg of drug for 4 weeks.	Rat	Decrease in systolic blood pressure.	[59]
40.	Berberin	Roots, rhizomes, *Coptis chinensis*, Ranunculaceae.	10 mg/kg of drug extract for 8 weeks.	Rat	Anti-hypertensive action.	[60]
41.	Cats claw	Leaves, *Uncaria tomantosa*, Rubiaceae	120 mg/kg of drug extract for 30 days.	Rat	Produces immune-toxic action.	[61]
42.	Celery	Seeds, *Apium graveolens*, Apiaceae.	40 mg/kg of drug extract.	Rat	Decreases blood pressure.	[62]
43.	Howthorn	Dried leaves, flowers, *Crataegus tanacetifolia*, Rosaceae.	100 mg/kg of drug extract for 4 weeks.	Rat	Lowering of blood pressure.	[63]
44.	Black cohosh	Roots, *Cimicifuga racemose*, Renunculaceae.	0.6 mg/kg of drug extract for 15 days.	Rat	An increase in the concentration of thiobarbituric acid in liver, caused oxidative damage, produced anti-hypertensive activity.	[64]

45.	Oat	Seeds, *Avena sativa*, Poaceae.	125, 250 & 500 mg/kg of drug extract for 10 days.	Rat	Cardioprotective activity.	[65]
46.	Ajwain	Seeds, *Trachyspermum ammi, Umbelliferae*	400 mg/kg of drug for 90 days.	Albino rabbit	Decrease in level of cholesterol.	[66]
47.	Ashoka	Bark, root of *Polyalthia longifolia*, Annonaceae	180 mg/kg of leaf extract of drug twice for 24 hrs.	Rat	Increases hypoglycaemic action, decreases blood pressure	[67]
48.	Vinca	Leaves, *Catharanthus roseus*, Apocynaceae	200 mg/kg of drug extract for 1 week.	Rat	Hypotensive effect.	[68]
49.	Radish	Leaves, *Raphanus sativus*, Raphanaceae.	0, 30 and 90 mg/kg of drug for 5 weeks.	Rat	Produces anti-hypertensive effect.	[69]

7. Future Prospective

In future, more research needs to be carried out in formulating a well-planned clinical research to clinically check the safety, efficacy and the appropriate dosage of herbal antihypertensive mechanisms in humans. Uniformity of herbal products, bioactive compound identification and characterization of its molecular actions will facilitate evidence based herbal medicine. An alternative possibility would be to combine herbal medicine with conventional antihypertensive drugs to take advantage of a synergistic effect and minimized side effects. Additionally, beneficial technology such as nanotechnology and new drug delivery modes could be applied to increase the bioavailability and therapeutic capacity of herbal remedies. The cooperation between pharmacologists, clinicians, and practitioners of traditional medicine can give new perspectives on integrative management of hypertension. Focus on personalized medicine in terms of genetics, lifestyle, and the environment will enhance the outcome of treatment even more [70].

Conclusion

It has been seen in this review that herbal medicines show a great potential in prevention of and management of hypertension. Other plants like hibiscus, tulsi, garlic, ginseng, ashwagandha or several other plants have shown some promising benefits in terms of antihypertensive effects, antioxidant effects as well as cardioprotective effects both experimentally and to a limited clinical extent. In contrast to conventional antihypertensive medicine, most commonly hypertension triggers considerable side effects including vertigo, tiredness, and renal disorders, herbal products present a low-side effects alternative weight gain and improved cardiovascular performance anti-lipidemic effects. Moreover, herbal medicines are affordable, culturally acceptable and accessible to most places; hence, they are ideal as long-term medication, particularly in areas with limited resources. Nevertheless, in spite of positive reports, there are still pressing questions regarding standardization, identification of active constituents, quality control, and clinical verification of a large scale. Further studies ought to be dedicated to clinical trials focused on high levels of objectivity, maximization of the dose regimen, and the identification of the synergistic effect with other existing therapies. All in all, the herbal medicines, once validated scientifically with standardization, have enormous potential of being used as complementary and /or alternative therapies to the comprehensive management of hypertension and its reduction of the global burden of cardiovascular diseases.

Acknowledgment

The authors sincerely acknowledge their respective institutions for providing the necessary facilities and academic support to carry out this review work. The authors are also grateful to colleagues and peers for their constructive suggestions during the preparation of the manuscript.

Author Contribution

RD; Conceptualization of the review, NB; Literature survey, PD; Manuscript drafting, ID; Critical analysis of literature.

Conflict of Interest

The authors declared that there is no conflict of interest.

Source of Funding

None

Ethical Approval

Not applicable

Data Availability

All data provided in the manuscript are original.

Reference

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