IJBPAS, May, 2022, 11(5): 2307-2319

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

MEDICINAL PLANTS COMBATING AGAINST HYPERTENSION

PATEL S[1*], TANDEL F[1] AND CHAKRABORTHY GS[2]

1: Research Scholar, Parul Institute of Pharmacy & Research, Parul University, Waghodia, Vadodara, Gujarat 391760

2: Parul Institute of Pharmacy, Parul University, Waghodia, Vadodara 391760

[*]**Corresponding Author: Sweta Patel:** sweta.patel19116@paruluniversity.ac.in

Received 18th May 2021; Revised 17th July 2021; Accepted 18th Aug. 2021; Available online 1st May 2022

https://doi.org/10.31032/IJBPAS/2022/11.5.6074

ABSTRACT

Plants are well known from the ages for treating various diseases and healing all the aliments as because of their lesser side effects and highest acceptability. The relationship between human beings and nature is an old age process since the civilization which has gained its importance slowly and rapidly now its roots are strengthen in every part of the continents. Plants are being used in the treatments like diabetes, ulceration, inflammation process, wound healing, hypertension and many more. One such silent disease is hypertension which people are facing more in this current era. Research has found a variety of alternative therapies to be successful in reducing high blood pressure including diet, exercise, stress, management, supplements and herbs. Nowadays, diseases like cardiovascular are at highest prevalent in mankind and their treatment is at highest priority because of the mechanism. Among cardiovascular diseases, hypertension is a serious cardiovascular disease and the mortality rate in the patients with this disease is nearly twice than the normal population. It significantly contributes to increase in sudden death which is seen by intensified risk factors such as smoking, diabetes, and hypercholesterolemia. Hence in order to control Herbal medication are used as they possess very lesser side effects, Some Plants like Punarnava, Garlic, Ginger, Arjuna, Ginseng are being widely used in controlling the pattern of Hypertension still it becomes a concern. Hence this review will be a breakthrough in identification of Herbal plants or its formulation associated with it to control the deadly disease.

Keywords: Hypertension, Herbal plants, Blood pressure, Phytoconstituents

INTRODUCTION

Hypertension (HTN) exerts a substantial public health burden on cardiovascular health status and healthcare systems in India **[1, 2]**. HTN is directly responsible for 57% of all stroke deaths and 24% of all coronary heart disease (CHD) deaths in India.

Causes:

- ✓ Acute causes of high blood pressure include stress, but it can happen on its own, or it can result from an underlying condition, such as kidney disease.
- ✓ physical inactivity
- ✓ a salt-rich diet associated with processed and fatty foods
- ✓ low potassium in the diet
- ✓ alcohol and tobacco use
- ✓ certain diseases and medications
- ✓ A family history of high blood pressure and poorly managed stress can also contribute.

Symptoms:

- ✓ sweating, anxiety, sleeping problems, and blushing
- ✓ If blood pressure reaches the level of a hypertensive crisis, a person may experience headaches and nosebleeds **[3]**.

Table 1: Overview of Blood pressure in normal condition and in Hypertension:

	Diastolic(mm/Hg)	Systolic (mmHg)
Normal Blood pressure	Less than 80	Less than 120
Elevated	Less than 80	Between 120 and 129
Stage 1 Hypertension	Between 80 and 89	Between 130 and 139
Stage 2 Hypertension	At least 90	At least 140
Hypertensive crisis	Over 120	Over 180

OVERVIEW ABOUT HERBAL MEDICINES: Natural products from plants, animals and minerals have been the basis of the treatment of human disease. Today estimate that about 80 % of people in developing countries still relays on traditional medicine based largely on species of plants and animals for their primary health care **[4]**.

Herbal medicines are currently in demand and their popularity is increasing day by day. About 500 plants with medicinal use are mentioned in ancient literature and around 800 plants have been used in indigenous systems of medicine. India is a vast repository of medicinal plants that are used in traditional medical treatments **[5]**. There has been an increase in demand for the Phytopharmaceutical products of Ayurveda in Western countries, because of the fact that the allopathic drugs have more side effects. Many pharmaceutical companies are now concentrating on manufacturing of herbal and

Phytopharmaceutical products **[6]**. In India, around 20,000 medicinal plants have been recorded. Chemical principles from natural sources have become much simpler and have contributed significantly to the development of new drugs from medicinal plants **[7-8]**.

HERBS USED TO TREAT HYPERTENSION

Chemical Classification of Antihypertensive Herbs:

- ✓ Alkaloids: Rauwolfia, Withania
- ✓ Terpenoids: Jalbrahmi
- ✓ Steroid: Satavari, Bhringringraj
- ✓ Flavanoids : Olive leaf, Hawthorn, Arjuna
- ✓ Volatile Oil : Black cumin seed, Ginger
- ✓ Sterols : Cat's claw
- ✓ Tannin: Arjuna

Pharmacological Classification of Antihypertensive Herbs:

- ✓ Centrally Acting: Withania (CNS acting); *Rauwolfia* (catcholamine depeleters)
- ✓ Vasodialators: Garlic (via hyperpolarisation through H_2S); Hawthorn, Olive leaf (endothelium dependent vasodilation)
- ✓ Diuretic : Punarnava
- ✓ Ca^{+2} channel blocker: Cat's claw
- ✓ ACE Inhibitors: Garlic (by allicin)
- ✓ Cholesterol Synthesis Inhibitors: *Hibiscus*

Table 2: Medicinal Plants Used For The Treatment Of Hypertension: [9-12]

S. No	Plant name	Parts used	Phytoconstituents
1.	Snakeroot	root	ajmaline, rescinnamine, serpentinine, sarpagine, deserpidine, and chandrine
2.	Garlic	Bulbils	sulfur containing compounds alliin, ajoene, diallylsulfide, dithiin, S-allylcysteine,
3.	Ginseng	root	ginsenoside
4.	St. John's wort	aerial parts	hypericin and hyperforin
5.	African mistletoe	leaves	Tender shoots—contain 10% tannins
6.	Scotch broom	Seeds	quinolizidine alkaloids; main alkaloids are (−)-sparteine, lupanine, ammodendrine and various derivatives; biogenic amines, including tryramine, epinine, dopamine; isoflavone glycosides including genistein, scoparin; flavonoids; essential oil; caffeic acid and p-coumaric acids; tannins. Seeds contain lectins
7.	Black cohosh	Root	triterpene glycosides- cycloartanes
8.	Cat's claw	Leaves	Rhynchophylline, hirsutine, and mitraphylline. Rhynchophylline . Three sterols —beta sitosterol (80%), stigmasterol, and campesterol.
9.	Lotus	Arial parts	alkaloids including liensinine, isoliensinine, referine, lotusine, methylcorypalline, and demethylcoclaurine. Among them, referine has been shown to have vasodilating effect and liensinine has antihypertensive and antiarrhymic abilities.
10.	Ginger	rhizomes	Volatile oil ; 3sesquiterpines:-bisaboline, zingiberene and zingiberol
11.	Ginkgo	Seed, leaf.	Phenolic acids; ginkgolic acid, hydroginkgolic acid, ginkgolides Flavonoids. Biflavonoids; sciadopitysin, ginkgetin, bilobetin .
12.	Golden seal	Rhizomes and roots	3 alkaloid hydrastine, berberine, canadine
13.	Hawthorn	Dried flowers, Fruits, leaves and twigs	flavonoids, catechins, triterpene saponins, amines, and oligomeric proanthocyanidins (OPCs)
14.	Mistletoe	leaves	Toxic protines,designated phoratoxin,viscotoxin

15.	**Stinging nettie**	**leaves, rootlets, rhizomes and cortex**	**acetylcholine, histamine and 5-hydroxytryptamine (5-HT). Acetylcholine is present in the leaves, rootlets, rhizomes and cortex in the ascending order of concentration.**
16.	**Jalbrahmi**	**Whole plant**	**pentacyclic triterpenes derivatives-madecassosides and asiaticosides.**
17.	**Black Cumin Seeds**	**seed**	**thymoquinone, dithymoquinone, thymohydroquinone, thymol, carvacrol, tanethole and 4-terpineol.**
18.	**Arjuna**	**bark**	**tannins, triterpenoid saponins, flavonoids, gallic acid, ellagic acid, OPCs, phytosterols, calcium, magnesium, zinc, and copper.**
19.	**Ashwagandha**	**Whole plant**	**Alkaloids including withanine, withananine, withananinine, pseudo-withanine, somnine, somniferine, somniferinine. The leaves of Indian chemotype contain withanolides, including withaferin A.**
20.	**Bhingaraj**	**leaves**	**wedelolactone and dimethyl wedelolactone, ascorbic acid. Alkaloid, ecliptine. thiophene derivatives mono-, di- and trithiophene acetylenes together with a-terthenyl in ß-sitosterol. The roots are very rich in thiophene acetylenes. active constituent, culumbin, exhibited remarkable antihypertensive activity**
21.	**Punarnava (Hogweed)**	**Whole plant**	**Punarnava contains b-Sitosterol, a-2-sitosterol, palmitic acid, ester of b-sitosterol, tetracosanoic, hexacosonoic, stearic, arachidic acid, urosilic acid, Hentriacontane, b- Ecdysone, triacontanol. Punarnavoside (antifibrinolytic glycoside) oeravinones, Lignans (liridodendrin, boeravine & hypoxanthine deriv .) ; Flavones, Sterols; Root contains Alanine, Arachidic acid, Aspartic acid, Behenic acid, Boerhavic acid, Boerhavone, Pottasium.nitrate (6.5 %), Oxalic acid, Punarnavine 1 and 2 etc.**
22.	**Satawari**	**tuberous dried root**	**saponins—shatavarins I–IV. Shatavarin IV is a glycoside of sarsasapogenin. dried root yields sitosterol; (dihydroxy-O hydroxyisobutyl) benzaldehyde and undecanyl cetanoate, and contains a large amount of saccharine matter, mucilage and minerals**
23.	**Alpinia**	**Whole plant**	**flavonoids [(+)-catechin; (-)-epicatechin; rutin; quercetin; kaempferol 3-O-rutinosideo; kaempferol 3-O-glucoronide; kaempferol] and kava pyrones (dihydro-5,6-dehydrokawain and 5,6-dehydrokawain)**
24.	**Ma Huang (Herba Ephedra)**	**Stem**	**Contain the phenylproamine alkaloids, l-ephedrine, d-pseudoephdrine. E. sinica contains 55-78% ephedrine and 12-23% pseudoephedrine.**
25.	**Chinese Angelica**	**Dried root**	**Root contains about 0.2-0.4% of essential oil , ferulic acid, ligusticide, angelicide, brefeldin A, butylphthalide, nicotinic acid, succinic acid and several coumarin constituents.**
26.	**Forskolin**	**Root**	**ditermene coleonol,**
27.	**Hibiscus**	**calyxes**	**Oxalic,malic,citric,tarteric andhibiscic acid**
28.	**Raisins**	**Seed extract**	**Grape skin produces endothelium dependent aorta relaxation possibly by its flovonoids (quercetin)**
29.	**Olive leaf**	**Leaf**	**Oleuropein, a complex structure of flavonoids, esters, and multiple iridoid glycosides,**
30.	**Yarrow**	**Dried arial parts with flower.**	**flavonoids and sesquiterpene lactone**

SPECIFIC PLANTS FOR THE TREATMENT OF HYPERTENSION:

Punarnava: Boerhavia diffusa or punarnava (Family: Nyctaginaceae) is a species of flowering plant that has a Lost of medicinal benefits. As per Ayurveda, punarnava is a plant that acts on six *Ayurvedic dhatus* (tissues) including blood, muscles, nerves, reproductive organs, plasma and fat. *Boerhaavia diffusa* L. (known as Punarnava means which rejuvenates or renews the body) is one of the most famous medicinal plants in the treatment of a large number of human ailments **[13]**. Boerhaavia species have been in phytochemical and pharmacological research due to their excellent medicinal values. They are rich sources of alkaloids, steroids and flavones. *Boerhaavia diffusa* has attracted a lot of

attention due to its prevalent uses in Ayurvedic system of medicine. It is widely used in jaundice, hepatitis, oedema, oligurea, anemia, inflammation, eye diseases, hypertension etc. It possesses significant antihypertensive properties that help keep high blood pressure in check. Moreover, it is a diuretic, which helps increase renal blood flow that further contributes to its antihypertensive actions Punarnavoside and boeravinones which are active antihypertensive agents of Punarnava which acts as Ca+2 channel antagonist. It also acts as diuretic by increasing renal blood flow by relaxing the smooth muscles of the arterial wall. Hydroalcoholic extract of punarnava used for treating hypertension **[14]**.

Garlic: *Allium sativum* (Family: Alliaceae or Liliaceae; Common name: Garlic) The bulb of garlic is commonly used for a variety of ailments. Garlic is used for hypertension, hyperlipidemia, coronary heart disease, age-related vascular changes and atherosclerosis, earaches, chronic fatigue syndrome (CFS), and menstrual disorders. Garlic is regarded as a potent platelet aggregation inhibitor. Many of the pharmacological effects of garlic are attributed to the allicin, ajoene, and other organosulfur constituents such as S- allyl-L-cysteine. Fresh garlic contains approximately 1% alliin .One milligram of alliin is converted to 0.458 mg allicin which is regarded as the major active compound in garlic **[15-17]**. Garlic has long been used for a variety of cardiovascular conditions, especially hyperlipidemia. It has also been reported to have hypotensive action. It is thought to increase nitric oxide production, resulting in smooth muscle relaxation and vasodilatation. One of the primary active compounds that gives garlic its characteristic odor and many of its healing benefits is called allicin. Aqueous extract of garlic used for treating hypertension **[18-19]**.

Cat´s claw: *Uncaria tomentosa* (Family: Aizoaceae) proliferates spontaneously all over the Amazon rainforest, especially in the upper Amazon region of Peru and neighboring countries, and other tropical areas of South and Central America. It has also been reported as far North as Belize, and South into Paraguay. There are as many as 60 species related to this plant **[13]**. Several different phytochemicals found in the water extract of *Uncaria tomentosa* have demonstrated different actions in the blood and heart. Some alkaloids contained in the extract have demonstrated hypotensive and vasodilating properties. These alkaloids are rhynchophylline, hirsutine, and mitraphylline **[20]**.

Rhynchophylline also has shown to inhibit platelet aggregation and thrombosis. The

analyses conducted there show that rhynchophylline has the ability to inhibit the accumulation of platelets and may also prevent and reduce blood clots in blood vessels and relax the blood vessels of endothelial cells, dilate peripheral blood vessels, lower the heart rate, and lower blood cholesterol. sterols —beta sitosterol (80%), stigmasterol, and campesterol—have been identified and proven to be mild inhibitors of cholesterol synthesis *in vitro* **[21]**. This also means that could help to prevent atherosclerosis, inhibiting the formation of the atherosclerotic plaque that occurs during the progression of atherosclerosis. All these effects may help to lower blood pressure. Methanolic extract of cat's claw used for treating hypertension **[22]**.

Ginseng (*panax ginseng*) (common name: man root Family: Araliaceae**):** A very popular plant root grown originally in China and today also in Japan, Korea and North America. Ginseng is commonly used as an adaptogenic agent for fatigue, insomnia, anxiety, depression and immune enhancement **[23]**. It is also used for increasing resistance to environmental stress and as a general enhancer of well-being. This herb is also used for improving physical and athletic performance, improving cognitive function, concentration and memory. Ginseng has a variety of active ingredients, consisting mainly of ginsenoid saponins. Ginsenoside as a active constituent in ginseng lowers blood pressure and acts as a CNS depressant **[24]**.

Ginseng is marketed either as a single herb compound or in combination with other herbs. The single herb compound is available in tablet as well as in alcoholic extracts (known as tinctures) intravenous administration of ginseng extract caused an immediate drop in blood pressure **[25]**. The effect was long lasting suggesting that it might be facilitated by a Calcium channel blocking like effect and interference with calcium mobilization into vascular smooth muscle cells. Rg1, one of the active ingredients in Ginseng can stimulate the production and release of nitric oxide (NO) from endothelial cells. Another ingredient, Ginsenoside Rb1 lowers blood pressure and acts as a CNS depressant. Methanolic extract of ginseng used for treating hypertension **[26]**.

Hawthorne (*Crataegus oxycantha and Crataegus monogyna*) (Family:Rosaceae common name: Thornapple)**:** Hawthorne has been used traditionally for cardiovascular disorders in many cultures. It contains a number of active constituents including flavonoids, catechins, triterpene saponins, amines, and oligomeric proanthocyanidins (OPCs). Hawthorne has been shown to exert a mild blood pressure lowering effect that can take up to four

weeks for maximal results. It is believed that the herb dilates coronary blood vessels **[27]**. One *in vitro* study on rat aorta found proanthocyanidins extracted from hawthorn relaxed vascular tone via endothelium-dependent nitric oxide-mediated relaxation. Methanolic extract of hawthorne is used for treating hypertension **[28]**.

Indian Snakeroot (*Rauwolfia serpentina*) (Family: Apocynaceae common name: sarpagandha): Rauwolfia is cultivated for the medicinal use of its 30 alkaloids (particularly reserpine found in the root), many used in treating hypertension **[29]**. Besides reserpine, other alkaloids used in hypertension and other cardiac disorders are ajmaline, rescinnamine, serpentinine, sarpagine, deserpidine, and chandrine. Rauwolfia alkaloids work by controlling nerve impulses along certain pathways that affect heart and blood vessels, lowering blood pressure. Rauwolfia depletes catecholamines and serotonin from nerves in the central nervous system **[30]**. The Rauwolfia constituent ajmaline not only lowers blood pressure, but also has a potent antiarrhythmic effect. Studies have shown that ajmaline specifically depresses intraventricular conduction, suggesting this would be particularly effective in the treatment of re-entrant ventricular arrhythmias. Rauwolfia has been used for anxiety and psychosis because at higher doses it tends to calm a person and slow them down. Hydroalcoholic extract of rauwolfia used for treating hypertension **[31]**.

Drumstick: *Moringa oleifera* (Family: Moringaceae; Common name: Murungai). In anesthetized rats, the crude extract of the leaves of *M. oleifera* caused a fall in systolic, diastolic, and mean BP in a dose-dependent manner **[32]**. The anti-hypertensive effect was brief, returning to normal within two minutes. It was also established that thiocarbamate and isothiocyanate fractions of the crude extract were responsible for the antihypertensive activity **[33]**.

Olive Leaf (*Olea africana and Olea europea*) (Family: Oleaceae): Olive leaf extract is derived from the leaves of the olive tree. The entire leaf extract contains several phytochemicals, including 20-percent oleuropein, a complex structure of flavonoids, esters, and multiple iridoid glycosides, which acts as a vasodilator, lowering blood pressure and preventing angina attacks **[34]**. Oleuropein is also being recognized as a potent antioxidant. Aqueous extract of olive leaf used for treating hypertension **[35]**.

Ashwagandha: (*Withania somnifera*) (Family: Solanaceae common name: Indian Winter cherry or Indian Ginseng) It is one of the most important herb of Ayurveda (the traditional system of medicine in India) used for millennia as a Rasayana for its

wide ranging health benefits **[36]**. Rasayana is described as an herbal or metallic preparation that promotes a youthful state of physical and mental health and expands happiness. These types of remedies are given to small children as tonics, and are also taken by the middle-aged and elderly to increase longevity. Among the ayurvedic Rasayana herbs, Ashwagandha holds the most prominent place **[37]**. It is known as "Sattvic Kapha Rasayana" Herb. Most of the Rasayana herbs are adaptogen / anti-stress agents. Ashwagandha is commonly available as a churna, a fine sieved powder that can be mixed with water, ghee (clarified butter) or honey **[38]**. It enhances the function of the brain and nervous system and improves the memory. It improves the function of the reproductive system promoting a healthy sexual and reproductive balance. Being a powerful adaptogen, it enhances the body's resilience to stress **[39-40]**. Ashwagandha improves the body's defense against disease by improving the cell-mediated immunity. It also possesses potent antioxidant properties that help protect against cellular damage caused by free radicals. Hydroalcoholic extract of ashwagandha used for treating hypertension **[41]**.

Black cumin seed *Nigella sativa*) (Family: Ranunculaceae) has a long history of medicinal use in various folk and traditional systems of medicine, including Iranian traditional medicine (ITM) **[42]**. These valuable medicinal seeds have been used traditionally against a variety of diseases such as dyspepsia, diabetes, headache, influenza and asthma **[43-44]**. *Nigella sativa* can be used as add on drug therapy in patients of metabolic syndrome with elevated blood pressure. nigella sativa oil has significant activity in hypertensive & dyslipidemic patients **[45-46]**. the various mechanisms that may be responsible for antihypertensive effect of *Nigella sativa* are centrally acting antihypertensive activity, calcium channel blocking activity and its diuretic activity **[47]**. the various components of *Nigella sativa* that may be responsible for its beneficial effects in metabolic syndrome are thymoquinone, thymol, various unsaturated fatty acids, lipase and tannins **[48]**.

The seed oil of NS was found to be rich in polyphenols and tocopherols. The seeds contain 36–38% fixed oils, 0.4–2.5% essential (volatile) oil, proteins, alkaloids, and saponins .The fixed oil is composedmainly of fatty acids, namely, linoleic (C18:2), oleic (C18:1), palmitic (C16:0), and stearic (C18:0) acids. Thymoquinone (TQ) is the most pharmacologically active ingredient found abundantly (30– 48%) in the black seeds, together with its derivatives such as dithymoquinone, thymohydroquinone, and

thymol. Dichloromethane extract of black cumin seed is used for antihypertensive activity **[49]**.

CONCLUSION

Hypertension is one of the leading health problems worldwide. This has been identified as one of the major cause of death in developed and developing countries. Moreover, the number of patients suffering from hypertension is increasing, and conventional medicine has not been effective in successfully treating the disease. Over the recent decades, Ayueveda medicinal plants have been proven to be effective in lowering blood pressure and improving heart functions. Some drugs are proved experimentally but numerous are yet to be revealed. This review article documented a number of medicinal plants and their mode of actions that have been reported to be effective in the management of hypertension in the field of Ayurveda. The study finds that the most researched and frequently utilized medicinal plants for the treatment of hypertension are Punarnava, Garlic, Cat's claw, Ginseng, Hawthorne, Indian snakeroot, and olive leaf. Furthermore, we find that there are scientific evidences of the use of some medicinal plants for the treatment of the disease. From the number of researches carried out at various institutions all over the world, it is clear that there is a lot of potential in herbal medicine to control hypertension. We believe that this review study will provide a basis for further scientific study to investigate the use of different plants in the treatment of different health issues. Thus, this kind of study will ultimately boost the use of traditional remedies due to an array of scientific evidence in its favour.

REFERENCES

[1] Leeder S, Raymond S, Greenberg H, Liu H. A race against time. The challenge of cardiovascular disease in developing economies. New York: Columbia University; 2004.

[2] Srinath Reddy K, Shah B, Varghese C, Ramadoss A. Responding to the threat of chronic diseases in India. Lancet 2005; 366: 1744–1749.

[3] Gupta R. Trends in hypertension epidemiology in India. J Hum Hypertens 2004; 18: 73–78.

[4] Conlin PR, Chow D, Miller ER. The effect of dietary patterns on blood pressure control in hypertensive patients: results from the Dietary Approaches to Stop Hypertension (DASH) trial. Am J Hypertens 2000; 13: 949-955

[5] Chopra RN, Nayar SL and Chopra I.C.Glossary of Indian medicinal plant, Council of scientific and industrial research, New Delhi, 1956, 1, 197.

[6] P. A. Cox, Ciba Foundation Symposium 154, Chichester, John Wiley & Sons, 40 1990; 23-27.

[7] Richard C, Jurgens M. Effects of natural health products on blood pressure. Ann Pharmacother. 2005; 39: 712–720.

[8] Khanal H, Joshi RK, Upadhyay A. Anti- hypertensive activity of Ayurvedic medicinal plants. *Int J Complement Alt Med.* 2020; 13(1): 7–12.

[9] International journal of pharmaceutical science and research "Herbal Remedies For Treatment of Hypertension" by Manish Agraval, D. Nandini, Vikas sharma, N.S.Chauhan.

[10] Conlin PR, Chow D, Miller ER. The effect of dietary patterns on blood pressure control in hypertensive patients: results from the Dietary Approaches to Stop Hypertension (DASH) trial. Am J Hypertens 2000; 13: 949-955

[11] Chopra RN, Nayar SL and Chopra I. C. Glossary of Indian medicinal plant, Council of scientific and industrial research, New Delhi, 1956, 1, 197.

[12] Dwivedi S, Agarwal MP. Antianginal and cardioprotective effects of *Terminalia arjuna*, an indigenous drug, in coronary artery disease. J Assoc Physicians India 1994; 42: 287-289.

[13] Vandana. S. Nade, laxman. A. Kawale, Anjali. B. Tajanpure "antihypertensive potential of boerhaavia diffusa l. in adrenaline-induced hypertensive model" Vol 5, Issue 1, 2015, 24-30.

[14] Bhowmik D, Kumar KS, Srivastava S, Paswan S, Sankar A, Dutta D. Traditional Indian herbs Punarnava and its medicinal importance. J Pharmacognosy Phytochem. 2012 May 1; 1(1): 52-8.

[15] Ried K, Frank OR, Stocks NP, Fakler P, Sullivan T. Effect of garlic on blood pressure: a systematic review and meta-analysis. BMC Cardiovasc Disord 2008; 8: 13.

[16] Ried K, Toben C, Fakler P. Effect of garlic on serum lipids: an updated meta-analysis. Nutr Rev 2013; 71: 282–99.

[17] Tesfaye A, Mengesha W. Traditional uses, phytochemistry and pharmacological properties of garlic (Allium Sativum) and its biological active compounds. Int. J. Sci. Res. Eng. Technol. 2015; 1: 142-8.

[18] Shakya SR, Labh SN. Medicinal uses of garlic (*Allium sativum*)

improves fish health and acts as an immunostimulant in aquaculture. European Journal of Biotechnology and Bioscience. 2014; 2(4): 44-7.

[19] Londhe VP, Gavasane AT, Nipate SS, Bandawane DD, Chaudhari PD. Role of garlic (*Allium sativum*) in various diseases: An overview. angiogenesis. 2011; 12: 13.

[20] Aquino R. "New polyhydroxylated triterpenes from Uncaria tomentosa." Journal of Natural Products 1990: 559-64.

[21] Keplinger K, Laus G, Wurm M. *Uncaria tomentosa* (Willd.) DC. ethnomedicinal use and new pharmacological, toxicological and botanical results. J Ethnopharmacol 1999; 64: 23-34100.

[22] Batiha GE, Magdy Beshbishy A, Wasef L, Elewa YH, El-Hack A, Mohamed E, Taha AE, Al-Sagheer AA, Devkota HP, Tufarelli V. *Uncaria tomentosa* (Willd. ex Schult.) DC.: A review on chemical constituents and biological activities. Applied Sciences. 2020 Jan; 10(8): 2668.

[23] Attele AS, Wu JA, Yuan CS. Ginseng pharmacology: multiple constituents and multiple actions. Biochem Pharmacol. 1999; 58:1685-1693.

[24] Vuksan V, Sievenpiper JL, Koo VY. American ginseng (*Panax quinquefolius L*) reduces postprandial glycemia in nondiabetic subjects and subjects with type 2 diabetes mellitus. Arch Intern Med. 2000; 160: 1009-1013.

[25] Kimura Y, Okuda H, Arichi S. Effects of various ginseng saponins on 5-hydroxytryptamine release and aggregation in human platelets. J Pharm Pharmacol. 1988; 40: 838-843.

[26] Kuo SC, Teng CM, Lee JC, Ko FN, Chen SC, Wu TS. Antiplatelet components in *Panax ginseng*. Planta Med. 1990; 56: 164-167.

[27] Lied TR, Kazandjian VA. A Hawthorne strategy: implications for performance measurement and improvement. Clinical performance and quality health care. 1998 Oct 1; 6: 201-4.

[28] McCambridge J, Witton J, Elbourne DR. Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. Journal of clinical epidemiology. 2014 Mar 1; 67(3): 267-77.

[29] Bunkar AR. Therapeutic uses of *Rauwolfia serpentina*. Int J Adv Sci Res. 2017; 2(2): 23

[30] Genest J, Adamkiewicz L, Robillard R, Tremblay G. Clinical Uses of *Rauwolfia*: I. In Arterial Hypertension. Canadian Medical Association Journal. 1955 Apr 1; 72(7): 483.

[31] Lobay D. *Rauwolfia* in the treatment of hypertension. Integrative Medicine: A Clinician's Journal. 2015 Jun; 14(3): 40

[32] Duke JA. Handbook of Medicinal Herbs. Boca Raton, FL: CRC Press Inc.; 1985: 401.

[33] Jayasree C. *Effectiveness of drumstick leaves tea among hypertensive clients in Thandalam village at Kanchipuram District* (Doctoral dissertation, Adhiparasakthi College of Nursing, Melmaruvathur).

[34] Visioli F, Bellosta S, Galli C. Oleuropein, the bitter principle of olives, enhances nitric oxide production by mouse macrophages. Life Sci 1998; 62: 541-546.

[35] Edgecombe SC, Stretch GL, Hayball PJ. Oleuropein, an polyphenol from olive oil, is poorly absorbed from isolated perfused rat intestine. J Nutr., 2000; 130: 2996-3002.

[36] Singh N, Bhalla M, de Jager P, Gilca M. An overview on *ashwagandha*: a Rasayana (rejuvenator) of Ayurveda. African Journal of Traditional, Complementary and Alternative Medicines. 2011; 8(5S).

[37] Kaur G, Singh N, Samuel SS, Bora HK, Sharma S, Pachauri SD, Dwivedi AK, Siddiqui HH, Hanif K. *Withania somnifera* shows a protective effect in monocrotaline-induced pulmonary hypertension. Pharmaceutical biology. 2015 Jan 2; 53(1): 147-57.

[38] Singh MP, Vashisht S, Chawla V, Mishra P. Comparative antistress effect of Vitis vinifera and Withania somnifera using unpredictable chronic mild stress model in rats. International Journal of Medical Research & Health Sciences. 2016; 5(7): 19-27.

[39] Jain H, Parial SD, Jarald E, Daud AS, Ahmad S. Extraction of Ashwagandha by conventional extraction methods and evaluation of its anti-stress activity. International Journal of Green Pharmacy (IJGP). 2010; 4(3).

[40] Kushwaha S, Betsy A, Chawla P. Effect of Ashwagandha (*Withania*

somnifera) root powder supplementation in treatment of hypertension. Studies on Ethno-Medicine. 2012 Aug 1; 6(2): 111-5.

[41] Mishra LC, Singh BB, Dagenais S. Scientific basis for the therapeutic use of *Withania somnifera* (ashwagandha): a review. Alternative medicine review. 2000 Aug 1; 5(4): 334-46.

[42] PN S, Anoop KR. Healing Hypertension: A focus on alternative systems of medicine. hypertension.; 140(159): 90-9.

[43] Joshi NJ, Shelke SA. Medicinal Plants as Calcium-channel Blockers Against Hypertension. vascular.; 1(3): 4-5.

[44] Jaarin K, Foong WD, Yeoh MH, Kamarul ZY, Qodriyah HM, Azman A, Zuhair JS, Juliana AH, Kamisah Y. Mechanisms of the antihypertensive effects of *Nigella sativa* oil in L-NAME-induced hypertensive rats. Clinics. 2015; 70: 751-7.

[45] Najmi AH, Nasiruddin MO, Khan RA, Haque SF. Indigenous herbal product *Nigella sativa* proved effective as an antihypertensive in metabolic syndrome. Asian J Pharm Clin Res. 2013; 6(1): 61-4.

[46] Dehkordi FR, Kamkhah AF. Antihypertensive effect of *Nigella sativa* seed extract in patients with mild hypertension. Fundamental & clinical pharmacology. 2008 Aug; 22(4): 447-52.

[47] Leong XF, Rais Mustafa M, Jaarin K. *Nigella sativa* and its protective role in oxidative stress and hypertension. Evidence-based complementary and alternative medicine. 2013 Jan 1; 2013.

[48] Ahmad A, Husain A, Mujeeb M, Khan SA, Najmi AK, Siddique NA, Damanhouri ZA, Anwar F. A review on therapeutic potential of *Nigella sativa*: A miracle herb. Asian Pacific journal of tropical biomedicine. 2013 May 1;3(5):337-52.

[49] Oskouei Z, Akaberi M, Hosseinzadeh H. A glance at black cumin (*Nigella sativa*) and its active constituent, thymoquinone, in ischemia: a review. Iranian journal of basic medical sciences. 2018 Dec; 21(12): 1200.