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Medicinal Plants of North-East India with Antihypertensive Activity: A Comprehensive Review

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Abstract: ***A great deal of interest has recently been shown in the use of herbs for the treatment of hypertension. Traditional medicine is an old name for an ancient kind of health care that existed prior to the application of science to health care. Hypertension is one of the leading various causes of major public health issue, and it also increase the risk of atherosclerosis and heart attack. There are many synthetic drugs available to treat hypertension in market but they may often cause many side effects, while herbs are generally well tolerated and have lesser side effects compare to synthetic drugs that's why nowadays, medicinal plants are utilised to treat hypertension and herbal medications are used by the majority of the population across the world. Because they are more widely accepted and medicinal herbs contain a variety of active ingredients like: flavonoids, tannins, glycosides etc. that have pharmacological and preventive activities and can be used to treat hypertension. In this study we discuss a list of thirty plants like: Allium sativum, Phyllanthus emblica, C. reticulata Blanco etc., that have antihypertensive properties which are mainly available in North East, India. And those plants are used by various tribes around north east for treatment of hypertension.***

Keywords: Hypertension, Herbal therapy, Allium sativum, Phyllanthus emblica, C. reticulata Blanco

1. Introduction

A growing number of patients are being diagnosed with hypertension, which is one of the most prevalent health conditions worldwide in both developed and developing nations. As a result, herbal medicinal plants have recently been shown to be effective in lowering blood pressure and enhancing heart function (1). Because the effects of chemical and synthetic drugs on the body of the patient are severe and herbal preparations have emerged as a potential source of therapeutic aids and are playing an increasingly important role in worldwide healthcare systems for all living beings, not only in diseased states but also as a potential material for sustaining good health (2). Nature has a plethora of natural vegetations and therapeutic plants to offer. It is estimated that there are around 350,000 higher plants in the world. The use of plants as a source of medicine has its roots in ethno veterinary medicine, which is based on traditional knowledge, and is an essential part of India's and the world's healthcare systems (3). Since prehistoric times, ethno medicine has grown and progressed. Traditional medicine is still the primary source of treatment for health-related issues all throughout the world. Despite globalisation and industrialization, natural and traditional medicine is used by 60-85% of the world's population in developing countries (4). Hypertension can be characterized as high blood pressure in the arteries, the vessels carrying blood from the heart to other parts of the body (5). Primary hypertension is a type of hypertension that has no medical etiology and affects 90 to 95 percent of people (6). There are many phytochemicals in plants and herbs that have proven effective in treating hypertension and it also have less side effects then other medicines (7). Hypertension is a lifestyle disease (8) and It has been predicted that by the year 2025, 29% of the world's adults, or almost 1.56 billion people, will suffer from hypertension (9). Uncontrolled hypertension puts you at risk for heart attack, heart failure, stroke, kidney illness, and retinal haemorrhage, among other things. Because most people have no symptoms and go unreported, hypertension has earned the term "silent-killer"(10). And also HTN is the most common risk factor for acute myocardial infarction, and is responsible for 16.5% of worldwide deaths. It is caused by a wide range of factors, including genetic and environmental components that contribute to dysfunctional BP regulation (11). According to (WHO 2008) high income countries have low rates of hypertension (35%), while low- income countries have high rates (40%) (12). Hypertension is a vascular system condition in which the entire vasculature is set at a specific level for a specific person. The cause of essential hypertension, which affects 95 percent of hypertensive individuals, is unknown (13). We can divided hypertension into two types primary (90- 95%) and secondary (5 - 10%) (14) hypertension and hypertension occurs in three stages.

1.1 Factors leading Hypertension:

- Stress
- Anxiety
- Tension
- Tobacco, Alcohol

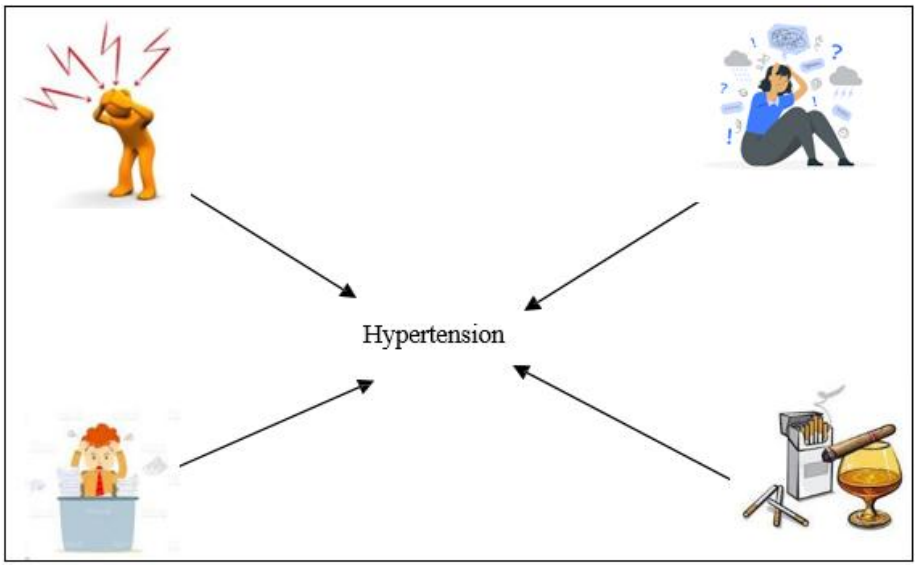

Figure 1: Factors leading to hypertension

There is a lot of evidence to suggest that using carefully selected herbal medicines and dietary supplements can help lower blood pressure and enhance the overall functioning of the heart, arteries, and cardiovascular system. Natural medicine has a number of advantages over conventional medicine, including the following:

- Compared to modern remedies and treatments, natural therapy is less expensive.
- Alternative therapies are easily accessible.
- A natural remedy made from herbs, vegetables, and fruits does not have any unwanted, undesired side effects, unlike allopathic medicines
- Natural remedies usually do not cause any reaction unless the prescribed dosage is not followed
- A natural remedy has fewer chances of affecting other bodily systems.
- The benefits of natural remedies, as general daily health supplements, go beyond curing the main disease but also soothe other body systems.
- Rather of focusing solely on symptoms, natural herbal medicines address the underlying cause. As a result, it aids in permanently ending a health issue (15).

1.2 Pathophysiology of hypertension:

Raised vascular resistance, as evidenced by decreasing vascular diameter due to increased vascular contraction and arterial remodelling, is one of the pathophysiological mechanisms implicated in the progression of HTN (16). Increases in the reninangiotensin- aldosterone system (RAAS), sympathetic nervous system stimulation, vasopressin, disturbed G protein-coupled receptor signalling, inflammation, different T-cell roles, and the diversity of vasoactive peptides secreted by other endothelial cells and smooth muscle cells all contribute to the pathophysiology of HTN (17). Enhanced vasoconstriction can be caused by increased arterial reactivity caused by deregulation of pro-oxidant enzymes and endothelial nitric oxide synthesis (eNOS), increased baseline and activated calcium levels via calcium channels, and the co-occurrence of VSMC hyperplasia and hypertrophy (18). Increased vascular stiffness promotes HTN and its complications, such as atherosclerosis, implying that therapy should target vascular stiffness rather than only peripheral vascular resistance (19,20). Angiotensin II (Ang II) has the ability to speed up the cell cycle (21). Other probable causes of HTN include hereditary disorders of renal sodium secretion, genetically related maladies of the Na/Ca2+ exchange in artery smooth muscles, and hormonal-neurogenic vasoconstriction (22).

Table 1: Medicinal plants and their mode of administration

S.N	Common name	Scientific name	Family name	Part use	Location	Mode of Administration/ Action	Chemical constituents	References
1	Pakkom	*Clerodendrum colebrookianum*	Lamiaceae	leaves	Assam	Make juice from leaves then give orally	Monoterpenes, flavonoids, sesquiterpenes, cyelohexylethanoids, anthraquinones, diterpenoids, phenylethanoid glycosides, cyanogenic glycosides.	Doley B, *et; al* 2022 (23)
2	Sarpagandha	*Rauvolfia serpentina*	Apocynaceae	Root	Assam	These are available in tablet and powder form which are take orally	Alkaloids, phenols, tannins, and flavanoiids	Doley B, *et; al* 2022 (23)
3	Rudraksha	*Elaeocarpus sphaericus*	Elaeocarpaceae	Seed	Assam	Five- faceted rudraksha in water	It consist glycosides, steroids, alkaloids, and	Doley B, *et; al* 2022

						ove night and drink the water in the morning.	flavanoids	(23)
4	Arjun	*Terminalia arjuna*	Combretaceae	Bark	Assam	2-3 g Arjuna powder mixed with water and take 1-2 times a day to reduce high blood pressure.	15% Tennins, Triterpenoid saponins Arjunolic acid, Arjunic acid, Arjunogenin	Doley B, *et; al* 2022 (23)
5	Rasun	*Allium sativum*	Liliaceae	bulb	Assam	Taken orally: Aged garlic extract, garlic oil, powder and in row form	Garlic contain 29% carbohydrates,56% proteins (albumin),0.1% fat, mucilage, 0.06-0.1% volatile oil. It also contain phosphorus, iron & copper.	Doley B, *et;al* 2022 (23)
6	Amloki	*Phyllanthus emblica*	Phyllantha ceae	fruit	Assam	Fruits are take orally	Ellagic acid, gallic acid Emblicanin A & B Phyllembein, quercetin and ascorbic acid	Doley B, *et;al* 2022 (23)
7	Amorlota	*Tinospora cordifoloa*	Menisperm aceae	leaves/ steam	Assam	Steam extract are taken orally	Alkaloids,diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds, and polysaccaharides	Doley B, *et; al* 2022 (23)
8	Fenugree (Methi shak)	*Trigonella foenum*	Fabaceae	seed	Assam	Seed take 1 glass of water, put 7-8 methi guti in it and allow it to mixed over night.	Carbohydrates, proteins, lipids, alkaloids, mineral,flavanoids, fibers, saponins,vitamin.	Barman, B.K, *et; al* 2020 (24)
9	Dhekia	*Diplazinum esculentum*	Dryopterid aceae	leaves & stem	Assam	Leaf and stem use as vegitable	Alkaloid, flavanoids, glycosides, phenolic, tannins,terpenoids, steroids,carbohydrate	Barman, B.K., *et, al2020* (24)
10	Tagara	*Veleriana jatamansi jones*	Valerianaceae	root	Nagaland	Root used as ingredient for hypertension	Patchoulol (24.3%) Alpha-bulnesene (13.8%) Isovaleric acid (12.9%) Alpha-guaiene (8.7%) 3-methylvaleric acid (8.4%).	Shankar R *et,al* 2012 (25)
11	Bortapipik	*Clerodendrum serratum*	Lamiaceae	whole plants	Arunachal Pradesh	Locally it is use as a vegetable	D-mannitol, Cleroflavone apigenin, scutellarein serratagenic acid acteoside,oleanolic acid,clerodermic acid y & beta – sitosterol cholestanol, clerosterol, campesterol, 24-ethyl cholesterol.	Perme N, Choudhury SN et, al 2015 (26)
12	East Indian glory bower	*Clerodendrum colebrookianum*	Verbenaceae	leaves and root	Arunachal Pradesh & Meghalaya	Used as vegetable	C-glandulosum are: Steroids, phenolics Terpenoids, flavanoids Tannin, glycosides and reducing sugars. Novel compounds are identified such as colebroside A(1), a diglucoside of fatty acid ester of glycerine.	Wangpan T, Tangjang S et.al 2020 (27)
13	Sickle senna	*Senna tora*	Ceasalpini aceae	leaves	Arunachal Pradesh	Leaf used for increase blood pressure	The leaves showed mainly the presence of Anthraquinone glycosides and flavanoids.	Kala CP 2005 (28)
14	Phunin	*Anaphalis contorta*	Asteraceae	seed and young shoot	Manipur	Seed and shoot give orally	The major constituents were β-caryophyllene (19.2%), γ-curcumene (17.5%), δ-cadinene (10.2%), labda–7,14–dien–13–ol (4.8%), epi-α- cadinol (4.3%), bulnesol (4.3%), α-cadinol (3.8%), β-bisabolol (3.7%) and labda–8,14–dien–13–ol (3.3%)	Khumbon gmayum, Ashalata Devi, M. L. Khan et, al 2005 (29)
15	Majengring	*Clerodendrum*	Lamiaceae	leaves	Manipur	Leaf cooked	Steroids, phenolics,	Panmei R, Gajurel

	Ganmakhui	*glandulosum*				or stewed as vegetable	terpenoids, flavonoids, tanin, glycosides.	
16	Indian trumpet flower (Nangi/ Ratambem)	*Oroxylum indicum*	Bignoniaceae	bark & flower	Manipur	Taken as vegetable (boiled/ Row).	. flavones and their glycosides, baicalein (5, 67-trihydroxy flavone) and its 6 and 7-glucuronides, chrysin (5,7-dihydroxy flavone) scutellarein and its 7-glucuronides, anthraquinone and aloe-Emodin [5,7,15], chrysin-7-O-glucuronide, chrysin-diglucoside and irridoid	Panmei R, Gajurel PR, et, al 2019 (30)
17	Awaphadigom (long coriander)	*Eryngium foetidum*	Apiaceae	leaves	Manipur	Leaf use as vegetable	The major compounds include dodecanal (3– 40%), (E)-2- hexenal (20–35%), decanal (4– 22%), (Z)-3-hexen-1-ol(4–31%, hexanal (1.7– 5.1%) and B-caryophyllene (1.7–2.3%).	Meetei SY, Singh PK et, al 2007 (31)
18	Kanghuman(Bengal salvia)	*Meriandra bengalensis*	Lamiaceae	leaves	Manipur	Leaf use as vegetable	It contains linalool (68.4%),1,8-cineole (17.4%) and a- terpineol (2.7%)	Meetei SY, Singh PK et,al 2007 (31)
19	Zerebliwa	*Cissus repens Lam*	Vitaceae	leaves	Nagaland	Leaf decoction is taken orally	Ursolic acid, Asiatic acid, lupeol etc	Kichu M, Malewska T et, al 2015 (32)
20	Bailshe(Passion fruit)	*Passiflora edulis*	Passifloraceae	leaves	Nagaland	Boiled leaf are eaten along with the extract	The P. edulis was associated with higher values of total phenolic, vitamin C, total carotenoids, AOX (DPPH•, ABTS+• and FRAP), cis-resveratrol, naringenin, kaempferol-3-glucoside, myricetin and procyanidin-B1	Bharali R, Bharali L, et, al 2017. (33)
21	Modhu (Honey)	*Apis cerana indica*	Apidae	fluid	All over north east	One table spoonful of honey is mixed with warm water and orally administered for quick recovery	The most abundant phytochemicals in the honey samples were phenols, sapogenin, sparteine, lunamarin, flavanone, and proanthocyanin, with mean concentrations 102.53 µg/g, 81.40 µg/, 58.92 µg/g, 42.84 µg/g, 36.14 µg/g and 27.56 µg/g respectively.	Mozhui L, Kakati LN et, al 2021 (34)
22	Santujri-so	*Cataranthu s roseus*	Apocynaceae	leaves	Assam	Leaves is taken directly for high blood pressure	Vinca leaves contain alkaloids like: Vinblastine (VBL), vinorelbine (VRL), vincristine (VCR) and vindesine (VDS)	Sajem AL, Gosai K. et, al 2006 (35)
23	Arrowleaf sida	*Sida rhombifolia*	Malvaceae	root	Meghalaya	Boiled in milk and consumed to maintain health	rhombifolia found aliphatics group cyclopropenoid fatty acid, myrstic acid, palmitic acid, stearic acid, oleic acid, and linoleic acid [12. Cyclopropenoid fatty acids in seed oils of Sida acuta and Sida rhombifolia	Singh B, Borthakur SK, et, al 2014 (36)
24	Kbarka(G)	*Stepbania japonica*	Menisperm aceae	root	Meghalaya	Crushed,boil ed with water, extract drunk	japonica contain alkaloids, steroids and fats. Stems contain bis-benzylisoquinoline alkaloids, stephasubine and 3′,4′-dihydro-stephasubine, saponins, steroids and fats. Roots contain the alkaloids, fangchinoline, dl- tetrandrine, d- tetrandrine and	Singh B, Borthakur SK, et, al 2014 (36)

							disochondrodendrine.	
25	Golpatta/Ghoratapray(gotu kola)	*Hydrocotyle asiatica*	Apiaceae	steams/ leafs	Sikkim	Make juice from leaves and steam and drink.Gotuk ola also available as tonic .	It mainly contain Terpenoids.	Sherpa MT, Mathur A et al 2015 (37)
26	Ginger (Adrak)	*Amomum zingiber*	Zingiberaceae	rhizome	Assam, Meghalaya	Drinking of water extract of dried rhizome for a month	Ginger contains 18-35% volatile oil,30.0% of gimgerol, shogaol & zingerone.	Basak S, Sarma GC et, al 2010 (38)
27	Basil	*Ocimum basilicum*	Lamiaceae	leaves	Assam	Make juice from leaves then drink regularly	0.1-0.9% volatile oil, 70% eugenol, 3% carvacrol, 20% eugenol- methyl-ether and also contain caryophyllin.	Devi AD, Devi OI, et, al 2014 (39)
28	Orange/ Komola	*C. reticulata Blanco*	Rutaceae	fruit	Manipur	Potassium, found in orange juice, is one of the finest minerals for lowering blood pressure.	It contain potassium, anti-oxidants,vitamin A & C, Calcium etc.	Devi AD, Devi OI, et, al 2014 (39)
29	Siikhasii (China berry)	*Melia azaderach Linn*	Meliaceae	Barks	Manipur	A handful of fresh peelings of the endoderm of the bark is crush or grounded and boiled with water and the decoction is taken for treating blood pressure.	Six compounds, benzyl 3-O-β-D-glucopyranosyl- 7-hydroxybenzoate (1), spathulenol (2), 1,7,8-trihydroxy-2-naphtaldehyde (3), quercetin (4), astragalin (5) and 2-methoxy-4-(2-propenyl) phenyl β-D-glucoside .	Lokho A. et, al 2012 (40)

2. Materials and Methods

This research is based on a comprehensive evaluation of literature from national and international journals. We looked at the findings of several studies on medicinal plants that have been used in the treatment of hypertension. In the systematic review we have focused on finding exact articles of Ethno botanical survey related to hypertension. The whole process of searching data and everything was followed by the guidelines of PRISMA (Preferred Reporting Items for Systemic Reviews and meta- analysis). The references discovered during the search were later consulted for information on the models or bio-assays used to test the effects of plant extracts on hypertension. In this review, experimental investigations on antihypertensive herbs have piqued people's interest.

Data sources and search strategy:
In this study, we used Elsevier, Science Direct, Springer Link (Springer), and search website like Pub Med, and Google Scholar to conduct a literature search. The terms "plants," "medicinal plants," and "plant extracts" were cross-referenced with "hypertension" and "antihypertensive action" in the search. And also specific keyword combinations like ethno botanical survey, northeast, hypertension, Medicinal plants; specific state of Northeast, Traditional hypertension plants etc.

Inclusion and exclusion criteria:
In inclusion criteria we have added the full- length text articles, Ethno botanical survey of northeast, articles only available in English language. Ethno botanical survey conducted only in north-east region. Articles for published in other language, Book chapters, plants for if ethno veterinary uses, Article is lacking sufficient information where also excluded.

Data Extraction:
Firstly titles and abstracts of various articles were thoroughly screened to exclude articles which are not related to the topic. Secondly plants only having antihypertensive activity where screened out in a table.

Data analyses and reporting:
Data obtained from the literature search where evaluated in detail and various information is like plant name family name scientific name mode of action plant parts used chemical constituents where screened out.

3. Results and Discussion

In this study we studied some medicinal plants which have antihypertensive properties and the antihypertensive effects of medicinal plants are not fully understood by traditional botanical research. It is possible to process medicinal plants to make natural medicines based on their safety and efficacy. However, their effectiveness should be confirmed through pharmacological research and clinical trials. It may be possible to clarify the effects of medicinal plants by studying the effects of longer randomized trials in the future. Furthermore, studies on several herbs with antihypertensive effects have so far yielded encouraging results, indicating that novel hypertension herbal drugs will be discovered in the near upcoming days. medicinal plants by studying the effects of longer randomized trials in the future. Furthermore, studies on several herbs with antihypertensive effects have so far yielded encouraging results, indicating that novel hypertension herbal drugs will be discovered in the near upcomeing days.

4. Conclusion

An epidemic of hypertension affects a large population of adults throughout the world, contributing to cardiovascular diseases. It is the result of an unknown or unidentifiable

pathology that is responsible for the elevated blood pressure. In addition to underlying pathology, certain medications may also cause secondary hypertension. For the treatment of hypertension, there are many allopathic but these medicines have variety of side effects compare to herbal medicine. Herbal medicines are popular among the people as herbal medicine is safe and compatible with the biological system and doesn't provoke adverse effects. And in case of herbal antihypertensive medicine these are able to reduce blood pressure and also improved the heart function. And that's why in this review article we dicuss outlined a number of medicinal plants, as well as their mechanisms of action, that have been shown to be beneficial in the treatment of hypertension. And there is no doubt that herbal medicine has a lot of potential to control hypertension. And we anticipate that this review study will serve as a foundation for future scientific research into the usage of various plants in the treatment of various health problems.

References

[1] Khanal H, Joshi RK, Upadhyay A. Anti-hypertensive activity of Ayurvedic medicinal plants. Int J Complement Alt Med. 2020;13(1):7-12
[2] Ozturk M, Altay V, Latiff A, Shareef S, Shaheen F, Iqbal Choudhry M. Potential medicinal plants used in the hypertension in Turkey, Pakistan, and Malaysia. InPlant and Human Health, Volume 1 2018 (pp. 595-618). Springer, Cham.
[3] Swargiary A, Roy MK, Daimari M. Survey and documentation of ethnobotanicals used in the traditional medicines system of tribal communities of Chirang district of Assam against helminthiasis. Biomedical and Pharmacology Journal. 2019 Dec 28;12(4):1923-35.
[4] Bhattacharyya R, Medhi KK, Borthakur SK, Borkataki S. An ethnobotanical study of medicinal plants used against jaundice by tea tribes of Morigaon District, Assam (India). Journal of Natural Remedies. 2020 Jan 31;20(1):16-28.
[5] Modak P, Halder S, Sarkar BK, Das A, Sarkar AP, Kundu SK. TRADITIONAL ANTIHYPERTENSIVE MEDICINAL PLANTS: A COMPREHENSIVE REVIEW.
[6] Kyrou I, Chrousos GP, Tsigos C. Stress, visceral obesity, and metabolic complications. Ann N Y Acad Sci, 2006; 1083: 77-110.
[7] Chrysant SG, Chrysant GS. Herbs used for the treatment of hypertension and their mechanism of action. Current hypertension reports. 2017 Sep;19(9):1-0.
[8] Chobanian AV, Bakris GL, Black HR, et al. The seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure: the JNC 7 report. JAMA. 2003;289(19):2560–2572.
[9] Roger VL, Go AS, Lloyd-Jones DM, Adams RJ, Berry JD, Brown TM, et al. Heart disease and stroke statistics--2011 update: a report from the American Heart Association. Circulation 2011;123(4): e18-e209. doi: 10.1161/ CIR.0b013e3182009701.
[10] Khanal H, Joshi RK, Upadhyay A. Anti-hypertensive activity of Ayurvedic medicinal plants. Int J Complement Alt Med. 2020;13(1):7-12.
[11] Kamyab R, Namdar H, Torbati M, Ghojazadeh M, Araj-Khodaei M, Fazljou SM. Medicinal plants in the treatment of hypertension: A review. Advanced Pharmaceutical Bulletin. 2021 Sep;11(4):601.
[12] Sultana S, Muhammad Asif H. Medicinal plants combating against hypertension: A green antihypertensive approach. Pakistan journal of pharmaceutical sciences. 2017 Nov 1;30(6).
[13] Saxena T, Ali AO, Saxena M. Pathophysiology of essential hypertension: an update. Expert review of cardiovascular therapy. 2018 Dec 2;16(12):879-87.
[14] World Health Organization (WHO) Resolution, promotion and development of training and research in traditional medicine, WHO document, 30, 1977, 49.
[15] Singh P, Mishra A, Singh P, Goswami S, Singh A, Tiwari KD. Hypertension and herbal plant for its treatment: a review. Indian Journal of Research in Pharmacy and Biotechnology. 2015 Sep 1;3(5):358.
[16] Kaur R, Khanna N. Pathophysiology and risk factors related to hypertension and its cure using herbal drugs. Spatula DD 2012;2(4):245-56. doi: 10.5455/spatula.20121223101221
[17] Rawat P, Singh PK, Kumar V. Anti-hypertensive medicinal plants and their mode of action. J Herb Med 2016;6(3):107- 18. doi: 10.1016/j.hermed.2016.06.001
[18] Lacolley P, Regnault V, Nicoletti A, Li Z, Michel JB. The vascular smooth muscle cell in arterial pathology: a cell that can take on multiple roles. Cardiovasc Res 2012;95(2):194- 204. doi: 10.1093/cvr/cvs135
[19] Sehgel NL, Zhu Y, Sun Z, Trzeciakowski JP, Hong Z, Hunter WC, et al. Increased vascular smooth muscle cell stiffness: a novel mechanism for aortic stiffness in hypertension. Am J Physiol Heart Circ Physiol 2013;305(9):H1281-7. doi: 10.1152/ajpheart.00232.2013
[20] Rostamzadeh D, Razavi SR, Esmaeili S, Dolati S, Ahmahi M, Sadreddini S, et al. Application of nanoparticle technology in the treatment of systemic lupus erythematous. Biomed Pharmacother 2016; 83: 1154-63. doi: 10.1016/j. biopha.2016.08.020
[21] Song P, Zou MH. Regulation of NAD(P)H oxidases by AMPK in cardiovascular systems. Free Radic Biol Med 2012;52(9):1607-19. doi: 10.1016/j. freeradbiomed.2012.01.025
[22] Zhang Y, Jose PA, Zeng C. Regulation of sodium transport in the proximal tubule by endothelin. Contrib Nephrol 2011; 172: 63-75. doi: 10.1159/000328684
[23] Doley B, Pegu D. Study of Ethnomedicinal Plants Used by the Mishing People for Diarrhea Disease. RESEARCH REVIEW International Journal of Multidisciplinary. 2022 Feb 20;7(2):40-5.
[24] Barman, B.K., 2020. Development of Horticulture and its Impact on the Economic Life of the Garos of Goalpara District of Assam.
[25] Shankar R, Devalla RB. Conservation of folk healing practices and commercial medicinal plants with special reference to Nagaland. International Journal of Biodiversity and Conservation. 2012 Mar 31;4(3):155-63
[26] Perme N, Choudhury SN, Choudhury R, Natung T, De B. Medicinal plants in traditional use at Arunachal Pradesh, India. International Journal of Phytopharmacy. 2015;5(5):86-98.
[27] Wangpan T, Tangjang S. Status of Medicinal Plants in

Context of Arunachal Pradesh. In Environmental concerns and sustainable development 2020 (pp. 63-80). Springer, Singapore
[28] Kala CP. Ethnomedicinal botany of the Apatani in the Eastern Himalayan region of India. Journal of ethnobiology and Ethnomedicine. 2005 Dec;1(1):1-8.
[29] Khumbongmayum, Ashalata Devi, M. L. Khan, and R. S. Tripathi. "Ethnomedicinal plants in the sacred groves of Manipur." (2005).
[30] Panmei R, Gajurel PR, Singh B. Ethnobotany of medicinal plants used by the Zeliangrong ethnic group of Manipur, northeast India. Journal of ethnopharmacology. 2019 May 10; 235: 164-82.
[31] Meetei SY, Singh PK. Survey for medicinal plants of Thoubal district, Manipur. Flora Fauna. 2007;13(2):355-8.
[32] Kichu M, Malewska T, Akter K, Imchen I, Harrington D, Kohen J, Vemulpad SR, Jamie JF. An ethnobotanical study of medicinal plants of Chungtia village, Nagaland, India. Journal of Ethnopharmacology. 2015 May 26; 166: 5-17.
[33] Bharali R, Bharali L, Singh DB. Ethno medicinal plants used in traditional health care by Chakhesang tribe of Phek district. Bulletin of Environment. Pharmacology and Life Sciences. 2017;6(1):46-9.
[34] Mozhui L, Kakati LN, Meyer-Rochow VB. Entomotherapy: a study of medicinal insects of seven ethnic groups in Nagaland, North-East India. Journal of ethnobiology and ethnomedicine. 2021 Dec;17(1):1-22.
[35] Sajem AL, Gosai K. Traditional use of medicinal plants by the Jaintia tribes in North Cachar Hills district of Assam, northeast India. Journal of ethnobiology and ethnomedicine. 2006 Dec;2(1):1-7.
[36] Singh B, Borthakur SK, Phukan SJ. A survey of ethnomedicinal plants utilized by the indigenous people of Garo Hills with special reference to the Nokrek Biosphere Reserve (Meghalaya), India. Journal of herbs, spices & medicinal plants. 2014 Jan 2;20(1):1-30.
[37] Sherpa MT, Mathur A, Das S. Medicinal plants and traditional medicine system of Sikkim: a review. World Journal of Pharmacy and Pharmaceutical Sciences. 2015;4(2):161-84.
[38] Basak S, Sarma GC, Rangan L. Ethnomedical uses of Zingiberaceous plants of Northeast India. Journal of ethnopharmacology. 2010 Oct 28;132(1):286-96.
[39] Devi AD, Devi OI, Singh TC, Singh EJ. A study of aromatic plant species especially in Thoubal district, Manipur, North East India. Int. J. Sci. Res. Publ. 2014; 4: 2250-3153.
[40] Lokho A. The folk medicinal plants of the Mao Naga in Manipur, North East India. International Journal of Scientific and Research Publications. 2012;2(6):1-8.