DOI:https://doi.org/10.54393/pbmj.v5i6.538

PAKISTAN BIOMEDICAL JOURNAL

https://www.pakistanbmj.com/journal/index.php/pbmj/index

Volume 5, Issue 6 (Jun 2022)

Systamatic Review

Anti-Hypertensive Effect of Gooseberry

Arooj Attique[1], Shahnai Basharat[1], Areeja Nasir[1], Huria Arooj[1], Samman Ishtiaq[2], Zunaira Zulqarnain[3], Ammara Akeel[4] and Misbah Arshad[1]*

[1]The University of Lahore, Lahore, Pakistan
[2]Rashid Latif Medical College, Lahore, Pakistan
[3]Punjab University, Lahore, Pakistan
[4]University of Agriculture (FSD), Faisalabad, Pakistan

ARTICLE INFO

Key Words:
Phyllanthus emblica, hypertension, Vitamin C, Polyphenol, Systolic and Diastolic blood pressure

How to Cite:
Attique, A. ., Basharat, S. ., Nasir, A. . ., Arooj, H. ., Ishtiaq, S. ., Zulqarnain, Z. ., Akeel, A. ., & Arshad, M. . (2022). Anti-Hypertensive Effect of Gooseberry: Anti-Hypertensive Effect of Gooseberry . Pakistan BioMedical Journal, 5(6). https://doi.org/10.54393/pbmj.v5i6.538

***Corresponding Author:**
Misbah Arshad
The University of Lahore, Lahore, Pakistan
fatimamisbah10@gmail.com

Received Date: 8th June, 2022
Acceptance Date: 25th June, 2022
Published Date: 30th June, 2022

ABSTRACT

Phyllanthus emblica, also known as emblic, Indian gooseberry, or amla, is a deciduous tree of the family Phyllanthaceae. The berries are tiny and round, with a bright or yellow-green in color. The Indian gooseberry (Phyllanthus emblica) is an Indian and Middle Eastern tree. For thousands of years, it has been prescribed in Ayurvedic treatment. **Objective:** The aim of this review was to identify scientific evidence regarding the effects of gooseberry on hypertension. **Methods:** Electronic search of Google scholar, Medline and PubMed databases were conducted. When the force of blood pushing against the walls of blood vessels, is consistently too high. It is known as hypertension. Scientific evidence indicates that polyphenols are central components in fruits and other sections of the amla tree, as well as vitamin **Results:** Previous studies suggested that Gooseberry is highly effective to manage hypertension. Indian gooseberries are able to keep both diastolic and systolic blood pressure levels in their normal ranges as well significantly decrease the high levels of both of them. It has other health benefits as well which includes normalizing blood sugar levels, protests against kidney disorders, several types of cancers, also prevents cancer from spreading to other parts of the body and many more health benefits. Most of the studies that were done on Phyllanthus emblica to determine their effects on high blood pressure of patients done by giving them in the form of capsules either in their aqueous state or in their dried powder form two or three times a day after meal for weeks. And the results were visible from second or fourth weeks onwards. **Conclusion:** These studies indicated that Indian gooseberries are highly efficient and a great remedy to treat hypertension

INTRODUCTION

Hypertension is one of the most common and major risk factors for the occurrence of cardiovascular diseases [1]. Hypertension is one of the most common and most rapidly growing diseases around the world which is also increasing the risks of more serious cardiovascular diseases as well [2]. It not only results in cardiovascular diseases but also accompany diseases like diabetes mellitus and dyslipidemia [3]. High blood pressure also increases the risk of coronary heart diseases, peripheral vascular diseases, retinal hemorrhage, vision loss and renal impairment [4]. Hypertension occurs when arterial blood pressure is abnormally high. Normal ranges of blood pressure are systolic <120 mmHg and that of diastolic is <80 mmHg. There's also a term known as prehypertension which is not a medical condition but if it's range is not controlled, it can lead to hypertension (Erem et al., 2009). Prehypertension ranges from systolic 120 - 139 mmHg and diastolic 80 - 89 mmHg. Hypertension occurs when blood pressure is equal or greater than 140 mmHg systolic and 90 mmHg diastolic [5,6]. Hypertension is sometimes unable to be diagnosed because it is initially asymptomatic. But if left untreated, it can result in stroke, heart attack and kidney failure [5,7]. Most common symptoms to detect high blood pressure are headaches, lightheadedness, blurry vision or in some cases even faintness [7]. According to a national family health survey held in 2015 and 2016, hypertension is

DOI:https://doi.org/10.54393/pbmj.v5i6.538

more prevalent in people of urban areas than those living in rural areas. The main reason for this is rapid urbanization and lifestyle changes which is unhealthy. Sedentary lifestyle and unhealthy eating habits are the most common reasons for the development of high blood pressure in the body along with high blood glucose levels, obesity and other several chronic diseases as well. Phyllanthus emblica, which is an Indian Gooseberry belonging to the family of Euphorbiaceae, is native to India and Southeast Asia. It is also known as amla or amla fruit. It is an important medicinal herb in Ayurvedic medicine [6]. Indian gooseberry is a deciduous tree in small to medium size. It is found abundantly in India, Pakistan, Sri Lanka, Malaysia, China, and South East Asia. The gooseberry plant is about 8 to 18 meters in height. It has a thin light gray bark with light green colored leaves and greenish yellow flowers. Its fruit is pale yellow in color, spherical in shape and fleshy [8]. Indian gooseberry is a highly nutritious fruit. It is a rich source of several amino acids and minerals. It also has high amounts of vitamin C in it [9]. The quantity of vitamin C found in Indian gooseberries is more than that present in citrus fruits such as lemons and oranges. Indian gooseberries also contain proteins, carbohydrates, and vitamin B complex. It has iron and phosphorus in abundance. The nutrients that are present in very low amounts in amla are saturated fats and sodium which means it is greatly beneficial to reduce heart diseases, hypertension and obesity [10]. Amla is also an important dietary source of various polyphenols of which tannins are found in abundance which has lower molecular weight and can be easily hydrolyzed in the body [11]. It also contains chemical constituents such as alkaloids and phenols which are also easily hydrolysable and more biologically active in the body [12]. It contains two types of hydrolysable tannins which are Emblicanin A and B [13]. Both of these have antioxidant properties. Emblicanin A gives glucose, gallic acid and ellagic acid upon hydrolysis whereas Emblicanin B gives only glucose and gallic acid [14]. Amla also contains flavonoids, of which most commonly found is quercetin. The alkaloids that are found in abundance in Indian gooseberries are phyllantine and phyllantidine [12]. Almost every part of the gooseberry plant has medicinal properties, but it's fruit holds the most importance in the treatment of various ailments. It has a lot of Ayurvedic properties and is used for the treatment of a number of various diseases [12]. It is highly used for the cure of diseases like heart diseases, high blood glucose as well as jaundice, diarrhea and hair problems. It is also used as laxatives and diuretics as well as a liver tonic [15]. There has been much research done on amla that shows its medicinal properties and makes it stand out in plant based medicine around the globe. This berry is also an important dietary source of polyphenolic compounds. According to various studies, it is reported that amla is most important in lowering high blood glucose, high cholesterol, and also has antioxidant and anti-inflammatory properties [16]. The free radical scavenging properties of amla prevent various types of cancers. It prevents cancer from spreading in the body as it has strong anti-mutagenic properties as well. It also prevents the need for chemotherapy and radiotherapy for cancer patients [16,17,18]. There have been many researches made that indicate the importance of Indian gooseberries in the treatment of heart diseases of which one of the most common is hypertension and hyperlipidemia. Hypertension can be a leading risk factor in the development of cardiovascular diseases which can be fatal for some patients as well. It is important to control this disease by raising awareness and by making healthy lifestyle changes in one's life. There are several low cost treatments available that can reduce the risk of developing hypertension. A study was conducted worldwide to measure the prevalence of hypertension and the methods of its diagnosis, treatment and controlling of its risk factors from the year 1990 to 2019. This study was conducted for over 200 countries. The data were collected from 1990 to 2019 of the patients aging from 30 to 79 years. The data contained all the hypertensive patients and the treatment they have received. Around 49% of men and 59% of women reported a previous diagnosis of hypertension globally. And 47% women and 38% men were treated. Around 23% of women and 18% of men have successfully controlled their hypertension as per reports globally. According to study, since 1990, treatment and control rate have been improved especially in high income countries as compared to low-income countries which have fewer improvements in controlling hypertension among patients [19]. A study was conducted to get to know the awareness about hypertension among patients of the age of above 18 years. The study was conducted on the patients belonging from rural and middle-class social group. The study was conducted on 202 patients out of which 49 (24%) were males and 153 (76%) were females. Around 80% of the patients know that hypertension can lead to severe cardiovascular diseases. Upon further inquiries, over 77% of these patients were not doing any physical activity and not avoiding oily foods to reduce their weight. A large number of patients use ghee for cooking purposes. The study concluded that more awareness is needed among patients on how to change their lifestyle so that hypertension can be prevented or controlled which can further help in the reduction of risk of developing cardiovascular diseases [20]. The Phyllanthus emblica fruit is considered to be highly efficient in lowering the risks of cardiovascular diseases out of which the most common

DOI:https://doi.org/10.54393/pbmj.v5i6.538

are high blood pressure and high cholesterol levels in the body. One of the studies indicate the efficiency of amla fruit in the prevention of hypertension, hyperlipidemia, arrhythmia, cardiotoxicity and heart failure. This study was performed on nineteen in vitro and animal samples. Its clinical trials were accessed by Jadad scale and animal studies were accessed by ARRIVE checklist. The study showed that Phyllanthus emblica influences various risk factors of cardiovascular diseases and can be efficient in protecting against serious heart problems [21]. Another study indicated that hypertension can be a reason for cardiovascular morbidity and motility as well. This study was conducted in 150 hypertensive patients which were given a capsule of 500mg of Phyllanthus emblica (in the form of aqueous extract) two times a day. It was added in their regular medication of the day for a period of 12 weeks in total. The effects of the capsule started showing the results of controlling blood pressure of the patients in 2, 4 and 8th weeks of the study. Other health parameters such as lipid profile, uric acid, oxidant and antioxidants enzyme levels and HbA1c were also measured at the end of the study. Phyllanthus emblica showed good results in controlling high blood pressure but did not additionally lower the diastolic and systolic blood pressure levels [22]. Another study was done on Phyllanthus emblica which was conducted on 12 patients of hypertension. In this study, the patients were given 250mg of Phyllanthus emblica extract in aqueous form two times a day for 14 days in total. The aqueous extract of Phyllanthus emblica was highly standardized on high performance liquid chromatography so that low molecular weight hydrolysable tannins can be obtained as well. These tannins include Emblicanin A, Emblicanin B, pedunculagin and punigluconin. Heart rate, augmentation pressure, radical and aortic blood pressure were assessed at the baseline of this study. The study showed significant decrease in the arterial stiffness by lowering radical and aortic blood pressure. The treatment was performed very well and did not show any adverse side effects [23]. A study was conducted on patients with primary hypertension. These patients were divided into two groups in which one used amla fruit and the other group used placebo with their routine medications. Amla was given in a 500mg capsule form three times a day after every meal. The placebo was also given in a 500mg of capsule three times a day after every meal. The capsule contained powder of dried amla fruit. The study continued for about a month. The study indicated that there was a significant difference in the condition of patients of hypertension. Their systolic and diastolic blood pressures were both controlled as compared to before taking the amla capsule [21]. Another study was performed on 20 patients of hypertension who were all men and also potential smokers. These people have compromised immune systems, decreased appetite, as well as cardiovascular abnormalities and also some other disorders. The group of 20 people were divided in half. Group with first 10 patients were given 250mg of Phyllanthus emblica fruit extract which contained almost 60% of hydrolysable tannins including Emblicanin A, Emblicanin B and punigluconin. It was given two times a day or after meals. The other group of 10 people received a placebo of 250mg capsule of the same ingredients including lactose, magnesium stearate and microcrystalline cellulose. The study continued for almost 60 days. The results were assessed by giving the participants a symptoms frequency questionnaire at the end of their trial. The subjective parameters that were assessed were mouth hygiene, cough, shortness of breath26, palpitations, heartburn and fatigue. The objective parameters that were assessed included blood pressure, lipid profile, lipoprotein A, high sensitivity C-reactive protein, fasting glucose, ECG. The results of the study indicated significant differences in the group given Phyllanthus emblica capsule as compared to those who were given placebo capsule. The blood pressure and lipid profile were much controlled [24]. Patients with uncontrolled hypertension were randomized divided into two equal groups. First group was assigned to take 500mg of Phyllanthus emblica in capsule form and the other group was assigned to take a placebo consisting of standard antihypertensive drugs. Both the capsules were assigned to take two times a day after meal for a time period of about eight weeks. Systolic blood pressure, diastolic blood pressure and heart rate were measured after 2,4,6 and 8 weeks of the study. The study indicated that systolic blood pressure was decreased by 8-15% in patients who were given Phyllanthus emblica capsules and 6-7% in those who were given placebo capsules. The study also indicated that diastolic blood pressure was decreased by 7-12% in the emblica group and 3-7% in the placebo group. This indicated that patients given Phyllanthus emblica reduced their blood pressure more efficiently than those patients who took standard hypertensive drugs [25]. Another study performed the effect of Indian gooseberries on blood pressure and lipid profile of the patients. In the study, a total of 60 patients were taken out of which 40 were given 500mg of Phyllanthus emblica powder and the rest of 20 patients were given 20mg of simvastatin as a placebo both in capsule form for 42 days. After 42 days, the samples of the patients were analyzed to determine the lipid profile as well as monitoring of blood pressure. The result of both the samples showed significant effect in the reduction of high blood pressure and controlled lipid profile of the patients but most effective results were given by Indian gooseberry. It provides significant protection against diseases like

DOI:https://doi.org/10.54393/pbmj.v5i6.538

coronary artery disease and atherosclerosis without having any negative effects on blood pressure and lipid profile of patients [26]. Another study was conducted on over 150 patients with essential hypertension. These patients were given an aqueous extract of 500mg of Phyllanthus emblica and placebo in capsule form for a time period of 12 weeks. Both the Phyllanthus emblica and placebo results were compared at the baseline and after the completion of 12 weeks. It showed that Phyllanthus emblica was significantly effective in reducing the blood pressure of patients with hypertension [3].

Research	Year	Sample Size	Results	Reference
Faculty opinions recommendation of worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019.	1990-2019	Over 200 countries	23% women 18% men successfully controlled their hypertension	19
Awareness of Hypertension among patients attending Primary Health Care Centre and Outpatient Department of tertiary care hospital of Karachi	2007	202 patients 49 males 153 females	80% of patients know hypertension and related risks. 77% of patients were not avoiding oily food, no physical activity.	20
The cardiovascular pharmacology of Emblica officinalis.	2018	19 vitro and animal samples.	Phyllanthus emblica shows effective In protecting against serious heart diseases.	21
Antihypertensive and pleiotropic effects of Phyllanthus emblica extract as an add -on therapy in patients with essential hypertension-A randomized double-blind placebo-controlled trial.	2021	150 hypertensive patients.	Phyllanthus emblica showed good results in controlling high blood pressure.	22
Evaluation of Phyllanthus emblica extract on cold pressor induced cardiovascular changes in healthy human subjects.	2014	12 patients with hypertension.	Significant decrease in the arterial stiffness by lowering radical and aortic blood pressure.	23
Evaluating the use of Emblica officinalis standardized fruit extract in cardio-respiratory improvement and antioxidant status of volunteers with smoking history.	2014	20 male smokers with hypertension.	Good results were shown in blood pressure, lipid profile, lipoprotein A, and on other tests.	24
A randomized, triple-blind, placebo-controlled, add-on clinical trial to evaluate the efficacy of emblica officinalis in uncontrolled hypertension.	2020	92 patients with uncontrolled hypertension.	Systolic blood pressure was decreased by 8-15% in patients. Diastolic blood pressure was decreased by 7-12%.	25
A comparative clinical study of hypolipidemic efficacy of Amla (Emblica officinalis) with 3-hydroxy-3-methylglutaryl-coenzyme-A reductase inhibitor simvastatin.	2012	60 patients.	Good amount of reduction shown in high blood pressure of patients and it controlled lipid profile of the patients.	26

CONCLUSIONS

It is concluded that Phyllanthus emblica which is also known as Indian gooseberry or amla/amla fruit is highly efficient in controlling high blood pressure. It also helps in maintaining lipid profile in its normal ranges and then further helps in protecting from various cardiovascular diseases. Indian gooseberries are able to keep both diastolic and systolic blood pressure levels in their normal ranges as well significantly decrease the high levels of both of them. It has other health benefits as well which includes normalizing blood sugar levels, protests against kidney disorders, several types of cancers, also prevents cancer from spreading to other parts of the body and many more health benefits. Most of the studies that were done on Phyllanthus emblica to determine their effects on high blood pressure of patients done by giving them in the form of capsules either in their aqueous state or in their dried powder form two or three times a day after meal for weeks. And the results were visible from second or fourth weeks onwards. These studies indicated that Indian gooseberries are highly efficient and a great remedy to treat hypertension.

REFERENCES

[1] Pickering GW. The natural history of hypertension. British medical bulletin. 1952 Jan; 8(4):305-9. doi: 10.1093/oxfordjournals.bmb.a074193.

[2] Shafi ST, Shafi T. A survey of hypertension prevalence, awareness, treatment, and control in health screening camps of rural central Punjab, Pakistan. Journal of epidemiology and global health. 2017 Jun; 7(2):135-140. doi: 10.1016/j.jegh.2017.01.001.

[3] Shanmugarajan D, Girish C, Harivenkatesh N, Chanaveerappa B, Prasanna Lakshmi NC. Antihypertensive and pleiotropic effects of Phyllanthus emblica extract as an add-on therapy in patients with essential hypertension-A randomized double-blind placebo-controlled trial. Phytotherapy Research. 2021 Jun; 35(6):3275-3285. doi: 10.1002/ptr.7043.

[4] Mendis S. World Health Organisation; 2010. Global status report on noncommunicable diseases 2010.

DOI:https://doi.org/10.54393/pbmj.v5i6.538

[5] Kumar M R, Shankar R, Singh S. Hypertension among the adults in rural Varanasi: a cross-sectional study on prevalence and health seeking behavior. Indian Journal of Preventive and Social Medicine. 2016;47(1-2):78–83.

[6] Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al. Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. National Heart, Lung, and Blood Institute; National High Blood Pressure Education Program Coordinating Committee. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension. 2003 Dec; 42(6):1206-52. doi: 10.1161/01.HYP.0000107251.49515.c2.

[7] Prabakaran J, Vijayalakshmi N, VenkataRao E. Prevalence of hypertension among urban adult population (25–64 years) of Nellore. International Journal of Research & Development of Health. 2013;1(2):42–49.

[8] Maurya U, Srivastava S, Traditional Indian herbal medicine used as antipyretic, antiulcer, anti-diabetic and anticancer: A review, International Journal of Research in Pharmaceutical Chemistry,2011; 1(4):1152-9.

[9] Srivasuki KP, Nutritional and health care benefits of Amla, Journal of Pharmacognosy,2012; 3(2):141-151.

[10] Dang GK, Parekar RR, Kamat SK, Scindia AM, Rege NN. Antiinflammatory activity of Phyllanthus emblica, Plumbago zeylanica and Cyperus rotundus in acute models of inflammation. Phytotherapy Research. 2011Jun;25(6):9048.doi:10.1002/ptr.3345.

[11] Bhandari PR, Kamdod MA. Emblica officinalis (Amla): a review of potential therapeutic applications. International Journal of Green Pharmacy (IJGP). 2012; 6:257–269.

[12] Udupa KN. Ayurveda for promotion of health. Journal of Ayurveda. 1985 Jan;3(3).

[13] Bhattacharya SK, Bhattacharya A, Sairam K, Ghosal S. Effect of bioactive tannoid principles of Emblica officinalis on ischemia-reperfusion-induced oxidative stress in rat heart. Phytomedicine. 2002 Mar; 9(2):171-4. doi: 10.1078/0944-7113-00090.

[14] Wang YF, Wang XY, Ren Z, Qian CW, Li YC, Kaio K, et al. Phyllaemblicin B inhibits Coxsackie virus B3 induced apoptosis and myocarditis. Antiviral Research. 2009 Nov; 84(2):150-8. doi: 10.1016/j.antiviral.2009.08.004.

[15] Perianayagam JB, Sharma SK, Joseph A, Christina AJ. Evaluation of anti-pyretic and analgesic activity of Emblica officinalis Gaertn. Journal of Ethnopharmacology. 2004 Nov;95(1):83-5. doi: 10.1016/j.jep.2004.06.020.

[16] Krishnaveni M, Mirunalini S. Chemopreventive efficacy of Phyllanthus emblica L. (amla) fruit extract on 7,12-dimethylbenz(a)anthracene induced oral carcinogenesis—a dose-response study. Environ Environmental toxicology and pharmacology.2012 Nov;34(3):801-10. doi: 10.1016/j.etap.2012.09.006.

[17] Adil MD, Kaiser P, Satti NK, Zargar AM, Vishwakarma RA, Tasduq SA. Effect of Emblica officinalis (fruit) against UVB-induced photo-aging in human skin fibroblasts. Journal of Ethnopharmacology. 2010 Oct; 132(1):109-14. doi: 10.1016/j.jep.2010.07.047.

[18] Deep G, Dhiman M, Rao AR, Kale RK. Chemopreventive potential of Triphala (a composite Indian drug) on benzo(a)pyrene induced forestomach tumorigenesis in murine tumor model system. Journal of experimental & clinical cancer research: CR. 2005 Dec; 24(4):555-63.

[19] Semplicini, A. Faculty opinions recommendation of worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: A pooled analysis of 1201 population-representative studies with 104 million participants. Faculty Opinions – Post-Publication Peer Review of the BiomedicalLiterature.2021.doi.org/10.3410/f.740693066.793589850

[20] Ashfaq T, Anjum Q, Siddiqui H, Shaikh S, Vohra EA. Awareness of hypertension among patients attending primary health care centre and outpatient department of tertiary care hospital of Karachi. Journal of Pakistan Medical Association. 2007 Aug; 57:396-8.

[21] Hashem-Dabaghian F, Ziaee M, Ghaffari S, Nabati F, Kianbakht S. A systematic review on the cardiovascular pharmacology of Emblica officinalis Gaertn. Journal of cardiovascular and thoracic research.2018;10(3):118128.doi:10.15171/jcvtr.2018.20

[22] Shanmugarajan D, Girish C, Harivenkatesh N, Chanaveerappa B, Prasanna Lakshmi NC. Antihypertensive and pleiotropic effects of Phyllanthus emblica extract as an add-on therapy in patients with essential hypertension-A randomized double-blind placebo-controlled trial. Phytotherapy Research. 2021 Jun; 35(6):3275-3285. doi: 10.1002/ptr.7043.

[23] Fatima N, Pingali U, Pilli R. Evaluation of Phyllanthus emblica extract on cold pressor induced cardiovascular changes in healthy human subjects. Pharmacognosy Research. 2014 Jan; 6(1):29-35. doi: 10.4103/0974-8490.122914

[24] Biswas TK, Chakrabarti S, Pandit S, Jana U, Dey SK. Pilot study evaluating the use of Emblica officinalis

DOI:https://doi.org/10.54393/pbmj.v5i6.538

standardized fruit extract in cardio-respiratory improvement and antioxidant status of volunteers with smoking history. Journal of Herbal Medicine. 2014 Dec; 4(4):188-194. doi.org/10.1016/j.hermed .2014.09.002

[25] Ghaffari S, Navabzadeh M, Ziaee M, Ghobadi A, Ghods R, Hashem-Dabaghian F. A Randomized, Triple-Blind, Placebo-Controlled, Add-On Clinical Trial to Evaluate the Efficacy of Emblica officinalis in Uncontrolled Hypertension. Evidence-Based Complementary and Alternative Medicine. 2020 Oct; 2020:8592869. doi: 10.1155/2020/8592869.

[26] Gopa B, Bhatt J, Hemavathi K G. A comparative clinical study of hypolipidemic efficacy of Amla (Emblica officinalis) with 3-hydroxy-3-methylglutaryl-coenzyme-A reductase inhibitor simvastatin. Indian journal of pharmacology. 2012 Mar; 44(2): 238–242. doi.org/10.4103/0253-7613.93857

[27] Khambatta, C. How does Amla Powder affect blood pressure? Amla Green. [Last accessed on January 9, 2022].Retrievedfromhttps://amlagreen.com/blogs/news/amla-powder-for-blood-pressure

[28] Erem C, Hacihasanoglu A, Kocak M, Deger O, Topbas M. Prevalence of prehypertension and hypertension and associated risk factors among Turkish adults: Trabzon Hypertension Study. Journal of public health.2009Mar;31(1):4758.doi:10.1093/pubmed/fdn078.

[29] Fisher ND, Williams GH. Hypertensive vascular disease. In: Kasper DL, Braunwald E, Fauci AS, et al. editors. Harrison's Principles of Internal Medicine. 16th. New York, NY, USA: McGraw-Hill; 2005;1463–1481.

[30] International Institute for Population Sciences. Ministry of Health and Family Welfare, Government of India. National family Health Survey (NFHS-4) 2015-16 Factsheet, India, http://rchiips.org/NFHS/pdf/NFHS4/India.pdf.

[31] Dev S. Ancient-modern concordance in Ayurvedic plants: some examples. Environmental health perspectives. 1999 Oct;107(10):783–789. doi.org/10.1289/ehp.99107783