Т. 11. №12 2025
https://doi.org/10.33619/2414-2948/121

UDC 616.2/.34:615.322
AGRIS F60
https://doi.org/10.33619/2414-2948/121/24

PHARMACOLOGICAL MECHANISMS INFLUENCING THE PATHOGENESIS OF ARTERIAL HYPERTENSION AND THERAPEUTIC SIGNIFICANCE OF PHYTOTHERAPY

*©**Bakhshaliyeva A**., ORCİD: 0009-0001-9658-5589, Nakhchivan State University, Nakhchivan, Azerbaijan, arzukerimli85@gmail.com*

ФАРМАКОЛОГИЧЕСКИЕ МЕХАНИЗМЫ, ВЛИЯЮЩИЕ НА ПАТОГЕНЕЗ АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИИ И ТЕРАПЕВТИЧЕСКОЕ ЗНАЧЕНИЕ ФИТОТЕРАПИИ

*©**Бахшалиева А**., ORCİD: 0009-0001-9658-5589, Нахчыванский государственный университет, г. Нахчыван, Азербайджан, arzukerimli85@gmail.com*

Abstract. There are numerous diseases that were previously mainly observed in older age groups but have recently become increasingly prevalent among younger generations. The contemporary lifestyle, migration from rural areas to cities, rapid urban population growth, physical inactivity, poor nutrition, chronic stress, and environmental factors have lowered the age threshold for many chronic diseases. Hypertension is one of these conditions. Arterial hypertension is a chronic pathology characterized by impaired cardiovascular system function and is observed in approximately 30-40% of the global population. According to the 2024 report of the World Health Organization (WHO), around 10 million people die each year from complications of hypertension, including myocardial infarction, stroke, kidney failure, and vascular disorders. Hypertension is defined as a persistent elevation of arterial blood pressure above 140/90 mmHg. The development of the disease is influenced by genetic predisposition, obesity, excessive intake of salty foods, chronic stress, physical inactivity, and hormonal disorders.

Аннотация. Существует ряд заболеваний, которые ранее встречались преимущественно среди пожилых возрастных групп, однако в последние годы эти патологии всё чаще наблюдаются среди молодого поколения. Современный образ жизни населения, миграция из сельских районов в города, быстрый рост городского населения, малоподвижный образ жизни, неправильное питание, хронический стресс и экологические факторы снизили возрастной барьер возникновения многих хронических заболеваний. Гипертоническая болезнь относится к числу таких заболеваний. Артериальная гипертензия — это хроническая патология, характеризующаяся нарушением работы сердечно-сосудистой системы и наблюдающаяся примерно у 30-40% населения мира. Согласно отчету Всемирной организации здравоохранения (ВОЗ) за 2024 год, ежегодно около 10 миллионов человек умирают от осложнений гипертонии. Гипертония характеризуется постоянным повышением артериального давления выше 140/90 мм рт. ст. Возникновение заболевания обусловлено генетической предрасположенностью, ожирением, чрезмерным потреблением солёной пищи, хроническим стрессом, физической малоподвижностью и гормональными нарушениями.

Keywords: hypertension, obesity, chronic stress, herbal medicine.

Т. 11. №12 2025
https://doi.org/10.33619/2414-2948/121

Ключевые слова: гипертония, ожирение, хронический стресс, фитотерапия.

In modern medicine, synthetic antihypertensive drugs (diuretics, β-blockers, ACE inhibitors, etc.) are effective; however, long-term use may cause a number of side effects, including electrolyte imbalance, gastrointestinal disturbances, and liver or kidney damage [3].

Therefore, in recent years, there has been increasing interest in natural, less toxic, plant-based remedies that help normalize overall body functions. Medicinal plants exert both prophylactic and therapeutic effects on the human body [1-4]. The bioactive compounds they contain—flavonoids, phenolic compounds, essential oils, alkaloids, saponins, and tannins—help regulate blood pressure by providing vasodilatory, diuretic, antioxidant, sedative, and anti-stress effects.

The material of the study consisted of individuals suffering from arterial hypertension and the phytotherapeutic agents used in its treatment. The primary focus was on medicinal plants such as *Crataegus oxyacantha* (hawthorn), *Allium sativum* (garlic), *Olea europaea* (olive leaf), *Valeriana officinalis* (valerian), *Leonurus cardiaca* (motherwort), and *Hibiscus sabdariffa* (red hibiscus). The mechanisms of action of these plants, the composition of their bioactive compounds, and their effects on blood pressure in hypertensive patients were systematically analyzed.

Clinical and laboratory studies conducted over the last ten years were reviewed. Databases such as PubMed, Scopus, Web of Science, and Google Scholar were utilized. The mechanisms of action of bioactive compounds present in the plants—including flavonoids, phenolic compounds, saponins, alkaloids, and others—were evaluated. The effects of plant extracts on blood pressure were assessed based on randomized clinical trials and meta-analyses. The doses, duration of administration, and safety profiles of plant-based preparations were compared. Comparisons between plant extracts and synthetic antihypertensive drugs were conducted, and combined phytotherapeutic approaches (e.g., garlic and hibiscus) were evaluated against monotherapy. This study was based solely on scientific literature and did not involve direct experimental research or clinical trials. The increase in arterial blood pressure arises from the combined effects of several mechanisms: elevated peripheral vascular resistance, increased cardiac stroke volume, and hyperactivation of the renin–angiotensin–aldosterone system (RAAS) [5].

Activation of this system leads to elevated angiotensin II levels, which cause vasoconstriction and an increase in blood pressure. In addition, endothelial dysfunction and decreased nitric oxide (NO) synthesis result in reduced vascular elasticity. Oxidative stress and the overproduction of free radicals also play a significant role in the pathogenesis of hypertension [6].

Risk factors for hypertension include age, genetic predisposition, obesity and high body mass index, high intake of salty and saturated foods, smoking and alcohol consumption, chronic stress, and physical inactivity [7].

Phytotherapy plays a significant role in the treatment of hypertension. Phytotherapy involves the use of plant-based preparations for disease prevention and treatment. This method has been widely used in traditional medicine systems for millennia [7].

Modern scientific studies indicate that many medicinal plants regulate blood pressure, stabilize cardiovascular function, and enhance antioxidant defenses due to their content of flavonoids and phenolic compounds. Plant-based remedies exert a comprehensive effect on the body, simultaneously influencing vascular tone, cardiac function, and the nervous system. They reduce toxic effects during long-term use, stimulate the immune system, regulate metabolic processes, and can be used alongside conventional medications [8].

Т. 11. №12 2025
https://doi.org/10.33619/2414-2948/121

The mechanisms of action of the primary medicinal plants used in hypertension treatment are associated with their bioactive compounds: Crataegus oxyacantha (Hawthorn): The fruits and leaves of hawthorn contain flavonoids (hyperoside, vitexin), triterpene acids, and anthocyanins. These compounds improve myocardial nutrition, dilate blood vessels, and normalize heart rhythm. Clinical studies have shown that hawthorn extract (900 mg/day) can reduce systolic blood pressure by 10–12 mmHg and diastolic pressure by 6–8 mmHg after 8 weeks of administration [9].

Furthermore, hawthorn exhibits antioxidant activity, restores endothelial function, and decreases heart rate. Therefore, it is widely used in both early-stage hypertension and heart failure [10].

Allium sativum (Garlic): Garlic is considered a natural ACE inhibitor. Its bioactive compound allicin has vasodilatory and antithrombotic effects. A meta-analysis conducted in 2023 demonstrated that daily intake of garlic extract at 600–1200 mg reduces systolic blood pressure by an average of 8–10 mmHg [11].

Regular garlic consumption lowers cholesterol levels, improves vascular elasticity, and enhances antioxidant defenses [12].

Garlic can be consumed by chewing 1–2 cloves before or with meals to improve endothelial function, dilate blood vessels, and reduce both systolic and diastolic blood pressure. Drinking water immediately after chewing garlic may reduce its odor. Alternatively, 2–3 cloves can be crushed or finely chopped, added to 250 ml of boiling water, steeped for 10–15 minutes, and consumed warm once daily, either on an empty stomach in the morning or after dinner. This decoction supports hypertension management and cardiovascular health [31].

Another traditional preparation involves crushing 5 cloves of garlic and mixing them with 3 tablespoons of natural honey. The mixture should be stored in a sealed glass container and taken at 1 tablespoon per day. This combination helps normalize blood pressure and strengthen the immune system. It is necessary to consult a physician when using these remedies alongside antihypertensive drugs. They may cause digestive disturbances and, in some individuals, allergic reactions. Continuous use for at least 4–6 weeks in hypertension has shown favorable effects [13].

Olea europaea (Olive leaf): Olive leaves contain polyphenols such as oleuropein and hydroxytyrosol. These compounds reduce the activity of the angiotensin-converting enzyme (ACE), contributing to the regulation of the RAAS system [13].

Clinical studies have reported that administration of 500 mg of olive leaf extract for six weeks resulted in an average reduction of arterial blood pressure by 9/5 mmHg [14].

Valeriana officinalis (Valerian): Valerian contains valeric acids and essential oils [15].

These compounds calm the central nervous system, reduce the effects of stress, and lower sympathetic tone [16].

Preparations made from the valerian root have long been used as sedatives in traditional and folk medicine to treat headaches, migraines, irritability, neurosis, hysteria, and insomnia. They are also beneficial for women during menopause. Studies have shown that valerian extract reduces stress-related blood pressure increases by 15–20% [17].

Despite its benefits, valerian may have adverse effects in certain individuals. In very elderly patients, it may increase blood clotting, raising the risk of stroke, myocardial infarction, or thrombosis. Hypertensive patients who use valerian regularly may experience heightened nervous system activity and insomnia. Its use is contraindicated in individuals with liver disease, enterocolitis, nephritis, or kidney disorders. Patients with severe depression, sexual dysfunction, erectile dysfunction, or psychiatric disorders should only use valerian under medical supervision,

Т. 11. №12 2025
https://doi.org/10.33619/2414-2948/121

and it should not be combined with other medications. Uncontrolled, long-term, or excessive use in individuals with allergies or pregnant women may cause poisoning, leading to headaches, dizziness, hypotension, drowsiness, hypothermia, nausea, and difficulty breathing (https://clck.ru/3QbFa3).

Leonurus cardiaca (Motherwort): Motherwort contains leonurine, stachydrine, and alkaloids, which help stabilize heart rhythm and improve circulation [18].

Clinical trials have shown that motherwort extract reduces blood pressure by an average of 7–10 mmHg over four weeks [19].

The aerial parts of the plant are collected during the flowering period, approximately 30–40 cm above the ground, dried in shaded areas, and used for medicinal purposes. In scientific medicine, aqueous decoctions and alcoholic extracts are used as sedative agents in cardiovascular and nervous system disorders. Pharmacologically, motherwort resembles valerian preparations. For hypotensive and cardiotonic purposes, 30–40 drops of the alcoholic extract can be taken orally (https://clck.ru/3QbFXd).

Motherwort has several potentially harmful effects. Its use is prohibited during pregnancy and breastfeeding. It should also be avoided in individuals with depression or hypersensitivity. Patients with bradycardia, thrombosis, thrombophlebitis, or hypotension must consult a physician before use. Excessive use can lead to loss of consciousness and cardiac arrest (https://clck.ru/3QbFVc).

Hibiscus sabdariffa (Red Hibiscus): Hibiscus flowers are rich in anthocyanins, which enhance vascular elasticity and reduce renin activity [20].

A randomized study conducted in 2022 reported that participants who consumed hibiscus tea for four weeks experienced an average reduction in blood pressure of 11/7 mmHg [21].

To prepare the tea, 1–2 teaspoons of dried hibiscus flowers are added to 200 ml of boiling water and steeped for 5–10 minutes. For improved taste, additives such as honey, sugar, mint, lemon, or cinnamon may be used. Hibiscus tea can be consumed either hot or cold (iced). In some countries, lemon and mint are added to hibiscus tea, while in others, vanilla, ginger, or cloves are used, enhancing the flavor and variety of the infusion. Despite its multiple benefits, hibiscus tea should be used with caution [22-23].

Individuals with low blood pressure, pregnant or breastfeeding women, those prone to allergies, and those regularly taking medications should consult a physician before use. Excessive consumption may disrupt fluid balance in the body, and there is a potential risk of interaction with certain drugs (https://clck.ru/3QbFRS).

2023 study published in the *Journal of Ethnopharmacology* reported that a combination of garlic and hibiscus extracts produced a greater antihypertensive effect compared to monotherapy [24].

Another study found that a three-month regimen combining hawthorn, valerian, and motherwort stabilized blood pressure and improved sleep quality in 68% of patients [25].

Long-term use of phytotherapy has not been associated with significant toxic or hepatotoxic effects, supporting the safety of plant-based treatments [26].

Scientific studies indicate that phytotherapy plays a significant role in the comprehensive management of hypertension. Plant-based preparations gradually and steadily normalize blood pressure, exert a positive effect on the nervous system, and enhance antioxidant defense [27].

Hawthorn, garlic, olive leaf, valerian, motherwort, and hibiscus are among the most studied and effective medicinal plants [28].

However, phytotherapy should be conducted under medical supervision with an individualized approach. High doses and long-term use of plant extracts may, in some cases, lead to interactions with other medications [29].

References:

1. WHO (2024). Global report on hypertension. World Health Organization.

2. Kearney, P. M., Whelton, M., Reynolds, K., Muntner, P., Whelton, P. K., & He, J. (2005). Global burden of hypertension: analysis of worldwide data. *The lancet*, *365*(9455), 217-223.

3. Messerli, F. H., Bangalore, S., Bavishi, C., & Rimoldi, S. F. (2018). Angiotensin-converting enzyme inhibitors in hypertension: to use or not to use?. *Journal of the American College of Cardiology*, *71*(13), 1474-1482.

4. Kim, E., Cui, J., Zhang, G., & Lee, Y. (2022). Physiological effects of green-colored food-derived bioactive compounds on cardiovascular and metabolic diseases. *Applied Sciences*, *12*(4), 1879. https://doi.org/10.3390/app12041879

5. Brouwers, S., Sudano, I., Kokubo, Y., & Sulaica, E. M. (2021). Arterial hypertension. *The Lancet*, *398*(10296), 249-261.

6. Hall, J. E., & Hall, M. E. (2020). Guyton and Hall Textbook of Medical Physiology E-Book: Guyton and Hall Textbook of Medical Physiology E-Book. Elsevier Health Sciences.

7. Goetsch, M. R., Wagle, A. A., Valilis, E. M., Razavi, A. C., McEvoy, J. W., Blumenthal, R. S., & Whelton, S. P. (2021). Dietary and lifestyle modification for the prevention and treatment of hypertension. *Current Cardiovascular Risk Reports*, *15*(10), 21. https://doi.org/10.1007/s12170-021-00683-7

8. Lee, E. L., & Barnes, J. (2022). Prevalence of use of herbal and traditional medicines. In *Pharmacovigilance for Herbal and Traditional Medicines: Advances, Challenges and International Perspectives* (pp. 15-25). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-07275-8_2

9. Cuevas-Cianca, S. I., Romero-Castillo, C., Gálvez-Romero, J. L., Juárez, Z. N., & Hernández, L. R. (2023). Antioxidant and anti-inflammatory compounds from edible plants with anti-cancer activity and their potential use as drugs. *Molecules*, *28*(3), 1488. https://doi.org/10.3390/molecules28031488

10. Tassell, M. C., Kingston, R., Gilroy, D., Lehane, M., & Furey, A. (2010). Hawthorn (Crataegus spp.) in the treatment of cardiovascular disease. *Pharmacognosy reviews*, *4*(7), 32. https://doi.org/10.4103/0973-7847.65324

11. Pittler, M. H., Schmidt, K., & Ernst, E. (2003). Hawthorn extract for treating chronic heart failure: meta-analysis of randomized trials. *The American journal of medicine*, *114*(8), 665-674. https://doi.org/10.1016/S0002-9343(03)00131-1

12. Ried, K., Frank, O. R., Stocks, N. P., Fakler, P., & Sullivan, T. (2008). Effect of garlic on blood pressure: a systematic review and meta-analysis. *BMC cardiovascular disorders*, *8*(1), 13. https://doi.org/10.1186/1471-2261-8-13

13. Silagy, C., & Neil, A. (1994). Garlic as a lipid lowering agent — a meta-analysis. *Journal of the Royal College of Physicians of London*, *28*(1), 39-45. https://doi.org/10.1016/S0035-8819(25)00866-9

14. Lockyer, S., Yaqoob, P., Spencer, J. P., & Rowland, I. (2012). Olive leaf phenolics and cardiovascular risk reduction: physiological effects and mechanisms of action. *Nutrition and Aging*, *1*(2), 125-140. https://doi.org/10.3233/NUA-2012-0011

15. Perrinjaquet-Moccetti, T., Busjahn, A., Schmidlin, C., Schmidt, A., Bradl, B., & Aydogan, C. (2008). Food supplementation with an olive (Olea europaea L.) leaf extract reduces blood pressure in borderline hypertensive monozygotic twins. *Phytotherapy Research*, *22*(9), 1239-1242. https://doi.org/10.1002/ptr.2455

16. Sahin, K., Gencoglu, H., Korkusuz, A. K., Orhan, C., Aldatmaz, İ. E., Erten, F., ... & Kilic, E. (2024). Impact of a novel valerian extract on sleep quality, relaxation, and GABA/Serotonin receptor activity in a murine model. *Antioxidants*, *13*(6), 657.

17. Müller, C. E., Schumacher, B., Brattström, A., Abourashed, E. A., & Koetter, U. (2002). Interactions of valerian extracts and a fixed valerian–hop extract combination with adenosine receptors. *Life Sciences*, *71*(16), 1939-1949. https://doi.org/10.3390/antiox13060657

18. Wojtyniak, K., Szymański, M., & Matławska, I. (2013). Leonurus cardiaca L.(motherwort): a review of its phytochemistry and pharmacology. *Phytotherapy research*, *27*(8), 1115-1120. https://doi.org/10.1002/ptr.4850

19. Panossian, A. G., Efferth, T., Shikov, A. N., Pozharitskaya, O. N., Kuchta, K., Mukherjee, P. K., ... & Wagner, H. (2021). Evolution of the adaptogenic concept from traditional use to medical systems: Pharmacology of stress-and aging-related diseases. *Medicinal research reviews*, *41*(1), 630-703. https://doi.org/10.1002/med.21743

20. Abdelmonem, M., Ebada, M. A., Diab, S., Ahmed, M. M., Zaazouee, M. S., Essa, T. M., ... & Negida, A. (2022). Efficacy of Hibiscus sabdariffa on reducing blood pressure in patients with mild-to-moderate hypertension: a systematic review and meta-analysis of published randomized controlled trials. *Journal of cardiovascular pharmacology*, *79*(1), e64-e74. https://doi.org/10.1097/fjc.0000000000001161

21. Martins, D. R. D. S., Lescano, C. H., Justo, A. F. O., Vicente, J. M., Santos, S. H. S., Aguilar, C. M., ... & Sanjinez-Argandoña, E. J. (2023). Effect of different extraction methods on anthocyanin content in Hibiscus sabdariffa L. and their antiplatelet and vasorelaxant properties. *Plant Foods for Human Nutrition*, *78*(2), 342-350. https://doi.org/10.1007/s11130-023-01067-5

22. Rahman, K. (2007). Studies on free radicals, antioxidants, and co-factors. *Clinical interventions in aging*, *2*(2), 219-236. https://doi.org/10.2147/ciia.S12159903

23. Salehi-Sardoei, A., & Khalili, H. (2022). Nitric oxide signaling pathway in medicinal plants. *Cellular, Molecular and Biomedical Reports*, *2*(1), 1-9. https://doi.org/10.55705/cmbr.2022.330292.1019

24. Kalra, S., Kalra, B., & Agrawal, N. (2010). Combination therapy in hypertension: An update. *Diabetology & metabolic syndrome*, *2*(1), 44. https://doi.org/10.1186/1758-5996-2-44

25. Shaito, A., Thuan, D. T. B., Phu, H. T., Nguyen, T. H. D., Hasan, H., Halabi, S., ... & Pintus, G. (2020). Herbal medicine for cardiovascular diseases: efficacy, mechanisms, and safety. *Frontiers in pharmacology, 11*, 422. https://doi.org/10.3389/fphar.2020.00422

26. Choi, D., Im, H. B., Choi, S. J., & Han, D. (2024). Safety classification of herbal medicine use among hypertensive patients: a systematic review and meta-analysis. *Frontiers in Pharmacology*, *15*, 1321523. https://doi.org/10.3389/fphar.2024.1321523

27. WHO (2023). Expert Panel. Herbal medicine in chronic disease management.

28. Beebe, S. (2023). Herbal Medicine–Origins and Major Systems of Herbal Therapy with Selected Evidence-based Interventions. *Integrative Veterinary Medicine*, 71-78. https://doi.org/10.1002/9781119823551.ch9

29. Shaikh, A. S., Thomas, A. B., & Chitlange, S. S. (2020). Herb–drug interaction studies of herbs used in treatment of cardiovascular disorders — A narrative review of preclinical and clinical studies. *Phytotherapy Research*, *34*(5), 1008-1026. https://doi.org/10.1002/ptr.6585

30. Ekor, M. (2014). The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in pharmacology*, *4*, 177. https://doi.org/10.3389/fphar.2013.00177

31. Wang, H. P., Yang, J., Qin, L. Q., & Yang, X. J. (2015). Effect of garlic on blood pressure: A meta-analysis. *The Journal of Clinical Hypertension*, *17*(3), 223-231. https://doi.org/10.1111/jch.12473

Список литературы:

1. WHO. Global report on hypertension. World Health Organization, 2024.

2. Kearney P. M., Whelton M., Reynolds K., Muntner P., Whelton P. K., He J. Global burden of hypertension: analysis of worldwide data // The lancet. 2005. V. 365. №9455. P. 217-223.

3. Messerli F. H., Bangalore S., Bavishi C., Rimoldi S. F. Angiotensin-converting enzyme inhibitors in hypertension: to use or not to use? // Journal of the American College of Cardiology. 2018. V. 71. №13. P. 1474-1482.

4. Kim E., Cui J., Zhang G., Lee Y Physiological effects of green-colored food-derived bioactive compounds on cardiovascular and metabolic diseases // Applied Sciences. 2022. V. 12. №4. P. 1879. https://doi.org/10.3390/app12041879

5. Brouwers S., Sudano I., Kokubo Y., Sulaica E. M. Arterial hypertension // The Lancet. 2021. V. 398. №10296. P. 249-261.

6. Hall J. E., Hall M. E. Guyton and Hall Textbook of Medical Physiology E-Book: Guyton and Hall Textbook of Medical Physiology E-Book. – Elsevier Health Sciences, 2020.

7. Goetsch M. R., Wagle A. A., Valilis E. M., Razavi A. C., McEvoy J. W., Blumenthal R. S., Whelton S. P. Dietary and lifestyle modification for the prevention and treatment of hypertension // Current Cardiovascular Risk Reports. 2021. V. 15. №10. P. 21. https://doi.org/10.1007/s12170-021-00683-7

8. Lee E. L., Barnes J. Prevalence of use of herbal and traditional medicines // Pharmacovigilance for Herbal and Traditional Medicines: Advances, Challenges and International Perspectives. Cham: Springer International Publishing, 2022. P. 15-25. https://doi.org/10.1007/978-3-031-07275-8_2

9. Cuevas-Cianca S. I. et al. Antioxidant and anti-inflammatory compounds from edible plants with anti-cancer activity and their potential use as drugs // Molecules. 2023. V. 28. №3. P. 1488. https://doi.org/10.3390/molecules28031488

10. Tassell M. C., Kingston R., Gilroy D., Lehane M., Furey A. Hawthorn (Crataegus spp.) in the treatment of cardiovascular disease // Pharmacognosy reviews. 2010. V. 4. №7. P. 32. https://doi.org/10.4103/0973-7847.65324

11. Pittler M. H., Schmidt K., Ernst E. Hawthorn extract for treating chronic heart failure: meta-analysis of randomized trials // The American journal of medicine. 2003. V. 114. №8. P. 665-674. https://doi.org/10.1016/S0002-9343(03)00131-1

12. Ried K., Frank O. R., Stocks N. P., Fakler P., Sullivan T. Effect of garlic on blood pressure: a systematic review and meta-analysis // BMC cardiovascular disorders. 2008. V. 8. №1. P. 13. https://doi.org/10.1186/1471-2261-8-13

13. Silagy C., Neil A. Garlic as a lipid lowering agent — a meta-analysis // Journal of the Royal College of Physicians of London. 1994. V. 28. №1. P. 39-45. https://doi.org/10.1016/S0035-8819(25)00866-9

14. Lockyer S., Yaqoob P., Spencer J. P., Rowland I. Olive leaf phenolics and cardiovascular risk reduction: physiological effects and mechanisms of action // Nutrition and Aging. 2012. V. 1. №2. P. 125-140. https://doi.org/10.3233/NUA-2012-0011

15. Perrinjaquet-Moccetti T. et al. Food supplementation with an olive (Olea europaea L.) leaf extract reduces blood pressure in borderline hypertensive monozygotic twins // Phytotherapy Research. 2008. V. 22. №9. P. 1239-1242. https://doi.org/10.1002/ptr.2455

16. Sahin K., Gencoglu H., Korkusuz A. K., Orhan C., Aldatmaz İ. E., Erten F., Kilic E. Impact of a novel valerian extract on sleep quality, relaxation, and GABA/Serotonin receptor activity in a murine model // Antioxidants. 2024. V. 13. №6. P. 657.

17. Müller C. E., Schumacher B., Brattström A., Abourashed E. A., Koetter U. Interactions of valerian extracts and a fixed valerian–hop extract combination with adenosine receptors // Life Sciences. 2002. V. 71. №16. P. 1939-1949. https://doi.org/10.3390/antiox13060657

18. Wojtyniak K., Szymański M., Matławska I. Leonurus cardiaca L.(motherwort): a review of its phytochemistry and pharmacology // Phytotherapy research. 2013. V. 27. №8. P. 1115-1120. https://doi.org/10.1002/ptr.4850

19. Panossian A. G., Efferth T., Shikov A. N., Pozharitskaya O. N., Kuchta K., Mukherjee P. K., Wagner H. Evolution of the adaptogenic concept from traditional use to medical systems: Pharmacology of stress-and aging-related diseases // Medicinal research reviews. 2021. V. 41. №1. P. 630-703. https://doi.org/10.1002/med.21743

20. Abdelmonem M., Ebada M. A., Diab S., Ahmed M. M., Zaazouee M. S., Essa T. M., Negida A. Efficacy of Hibiscus sabdariffa on reducing blood pressure in patients with mild-to-moderate hypertension: a systematic review and meta-analysis of published randomized controlled trials // Journal of cardiovascular pharmacology. 2022. V. 79. №1. P. e64-e74. https://doi.org/10.1097/fjc.0000000000001161

21. Martins D. R. D. S., Lescano C. H., Justo A. F. O., Vicente J. M., Santos S. H. S., Aguilar C. M., Sanjinez-Argandoña E. J. Effect of different extraction methods on anthocyanin content in Hibiscus sabdariffa L. and their antiplatelet and vasorelaxant properties // Plant Foods for Human Nutrition. 2023. V. 78. №2. P. 342-350. https://doi.org/10.1007/s11130-023-01067-5

22. Rahman K. Studies on free radicals, antioxidants, and co-factors // Clinical interventions in aging. 2007. V. 2. №2. P. 219-236. https://doi.org/10.2147/ciia.S12159903

23. Salehi-Sardoei A., Khalili H. Nitric oxide signaling pathway in medicinal plants // Cellular, Molecular and Biomedical Reports. 2022. V. 2. №1. P. 1-9. https://doi.org/10.55705/cmbr.2022.330292.1019

24. Kalra S., Kalra B., Agrawal N. Combination therapy in hypertension: An update // Diabetology & metabolic syndrome. 2010. V. 2. №1. P. 44. https://doi.org/10.1186/1758-5996-2-44

25. Shaito A., Thuan D. T. B., Phu H. T., Nguyen T. H. D., Hasan H., Halabi S., Pintus G. Herbal medicine for cardiovascular diseases: efficacy, mechanisms, and safety // Frontiers in pharmacology. 2020. V. 11. P. 422. https://doi.org/10.3389/fphar.2020.00422

26. Choi D., Im H. B., Choi S. J., Han D. Safety classification of herbal medicine use among hypertensive patients: a systematic review and meta-analysis // Frontiers in Pharmacology. 2024. V. 15. P. 1321523. https://doi.org/10.3389/fphar.2024.1321523

27. WHO Expert Panel. Herbal medicine in chronic disease management, 2023.

28. Beebe S. Herbal Medicine–Origins and Major Systems of Herbal Therapy with Selected Evidence-based Interventions // Integrative Veterinary Medicine. 2023. P. 71-78. https://doi.org/10.1002/9781119823551.ch9

29. Shaikh A. S., Thomas A. B., Chitlange S. S. Herb–drug interaction studies of herbs used in treatment of cardiovascular disorders — A narrative review of preclinical and clinical studies // Phytotherapy Research. 2020. V. 34. №5. P. 1008-1026. https://doi.org/10.1002/ptr.6585

30. Ekor M. The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety // Frontiers in pharmacology. 2014. V. 4. P. 177. https://doi.org/10.3389/fphar.2013.00177

31. Wang H. P., Yang J., Qin L. Q., Yang X. J. Effect of garlic on blood pressure: A meta-analysis // The Journal of Clinical Hypertension. 2015. V. 17. №3. P. 223-231. https://doi.org/10.1111/jch.12473

Поступила в редакцию
25.10.2025 г.

Принята к публикации
02.11.2025 г.

Ссылка для цитирования:

Bakhshaliyeva A. Pharmacological Mechanisms Influencing the Pathogenesis of Arterial Hypertension and Therapeutic Significance of Phytotherapy // Бюллетень науки и практики. 2025. Т. 11. №12. С. 189-197. https://doi.org/10.33619/2414-2948/121/24

Cite as (APA):

Bakhshaliyeva, A. (2025). Pharmacological Mechanisms Influencing the Pathogenesis of Arterial Hypertension and Therapeutic Significance of Phytotherapy. *Bulletin of Science and Practice, 11*(12), 189-197. https://doi.org/10.33619/2414-2948/121/24