WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 10, 12-28. Review Article ISSN 2277–7105

PREPARATIONS AND EVALUATION ASHWAGANDHA CAPSULE FOR ANTIARRHYTHMIC PROPERTIES

Neha Rathod*[1], Pranali Ambilwade[2], Vaishnavi Jakhad[3], Jayashri Chavan[4], Navnath Chavan[5] and Satyapal Chavan[6]

Student, At. Post. Aandhaner, Kannad, Maharashtra, India.

Article Received on
27 March 2025,

Revised on 16 April 2025,
Accepted on 06 May 2025

DOI: 10.20959/wjpr202510-36161

***Corresponding Author**
Neha Rathod
Student, At. Post.
Aandhaner, Kannad,
Maharashtra, India.

ABSTRACT

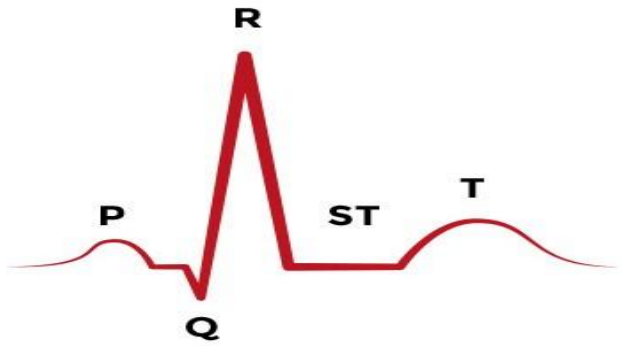
Among the most prevalent heart conditions is arrhythmia. The search for new drugs to suppress various heart diseases is always of great interest. In the last decade, there has been a lot of attention in the investigation of potent antiarrhythmic substances from plants. These natural compounds exhibit antiarrhythmic effects and chemical modifications on natural compounds have greatly increased their therapeutic properties. Herbal antiarrhythmic medication chemical modification is directly linked to new drug development and marketing. Thus, this study will discuss the structural characteristics and mechanisms of natural compounds' action that have antiarrhythmic activities so that chemists can select the primary antiarrhythmic compounds. from natural compounds. on the target of the disease - chemical structures. Coordinated ion channel and transporter activity is necessary for the well-ordered transmission of electrical impulses across the heart and the maintenance of a regular cardiac rhythm. The presence of structural cardiac disease resulting from myocardial infarction (owing to fibrotic scar development) or left ventricular dysfunction significantly increases the risk of common acquired arrhythmias.

KEYWORDS: Arrhythmia, Cardiovascular, Myocardial infraction, Fibrotic scar.

INTRODUCTION

A cardiac arrhythmia is an irregular heartbeat that affects how hard the heart pumps blood. Arrhythmias can be classified by heart rate as tachyarrhythmias (above 100 beats per minute in adults), bradycardia (below 60 beats per minute), or breathing. Arrhythmias again classified based on where they originate, such as supraventricular or ventricular arrhythmias,

where the arrhythmia begins in the atria or ventricles, respectively, in the atrial phase or ventricular fibrillation.[1] In clinical practice, atrial fibrillation (supraventricular tachyarrhythmia caused by atrial activation and atrial mechanical failure) is a general cardiac arrhythmia caused mainly by structural and electrophysiological changes in the tissue. atrial It can occur in the absence of heart disease, but is often seen in association with mitral valve disease, heart failure, ischemic heart disease and hypertension. high Early manifestations of atrial fibrillation can be controlled with medication.[2] Arrhythmia is an irregular heart rate that is considered the main cause of heart disease and accounts for 80% of sudden cardiac deaths. There are many heart diseases called arrhythmias such as: atrial fibrillation (AF), ventricular fibrillation (VF), premature ventricular contraction (PVC), tachycardia and bradycardia. Early detection of arrhythmia can save the patient's life. CVD is diagnosed using an electrocardiograph (ECG), a waveform that shows the heart's electrical activity, and is recorded using electrodes attached to the patient's chest. A normal ECG signal can be divided into P, QRS and T waves.



The ECG signal shows the conduction of electrical impulses from the atria to the ventricles. The P wave is the first element in a normal ECG wave. It indicates atrial contraction. The QRS indicates the beginning of contraction of the ventricles. This contraction pushes the blood through the ventricles.it pushes into the veins and creates a pulse. The T wave represents relaxation of the ventricles.

Table 1: Amplitude and duration in a normal ECG.

Interval	Amplitude	Duration
P	0.2 - 0.25 mV	0.06 - 0.12 s
QRS	0.5 - 3mV	0.06 - 0.1s
T	0.1 -0.8mV	0.05 - 0.25 s

Table 1 shows the amplitude and duration of each wave in a normal ECG.[3] Obesity and overweight have several negative consequences on cardiovascular (CV) and overall health. Obesity undoubtedly exacerbates the majority of the primary CV risk factors, such as blood pressure, hyperglycemia, inflammation, and plasma lipids. It also puts an excessive amount of strain on the heart, adversely influencing systolic and diastolic ventricular function as well as ventricular shape 3, 5, 6. It should come as no surprise that obesity raises the risk of the majority of CV conditions, such as hypertension, heart failure (HF), coronary heart disease (CHD), and atrial fibrillation (AF) 3, 5. However, a wealth of evidence, primarily presented in the last ten years, has shown a phenomenon known as the "obesity paradox," according to which patients with cardiovascular problems who are fat typically have a better short- and long-term prognosis than their thinner counterparts 3,5.[4]

Litreture review

1. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from journal of pharmacology and molecular cellular cardiology, 2022; 166: 107-115.
2. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from (2023) journal of cardiac arrhythmias and treatment strategies pharmaceutical, 16(6): 844.
3. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from (2021) ASHWAGANDHA (WITHANIA SOMNIFERA): international journal of Research in Ayurveda and pharmacy, 12(2): 132-139.
4. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from INTERNATIONAL JOURNAL OF PHARMACEUTICAL EDUCATION AND RESARCH (IJPER)., 8 Jan. 2020; 1(2): pp. 33-37.
5. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from Journal of Medicinal Plants Research, 25 Oct. 2012; 6(41): pp. 5388–5399.
6. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from (2020) Atrial Fibrillation: Diagnosis, Treatment and Outcomes- A Case Study. Scholars Journal of Medical Case Reports, 8(12): 1012–1019.
7. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from (2023)Journal of Clinical Medicine, 12(12): 4171.

8. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from Journal of Pharmaceutical Research, 1 Oct. 2004; 3(4): p. 57.
9. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from Journal of Pharmaceutical and Clinical Research, 7 Nov. 2018; 11(11): p. 280.
10. Review of litreture for praparation and evaluation ashwagandha capsule for antiarrhythmic properties from Journal of Pharmaceutical Sciences, Sept. 1974; 63(9): pp. 1494–1495.

Type of arrhythmia

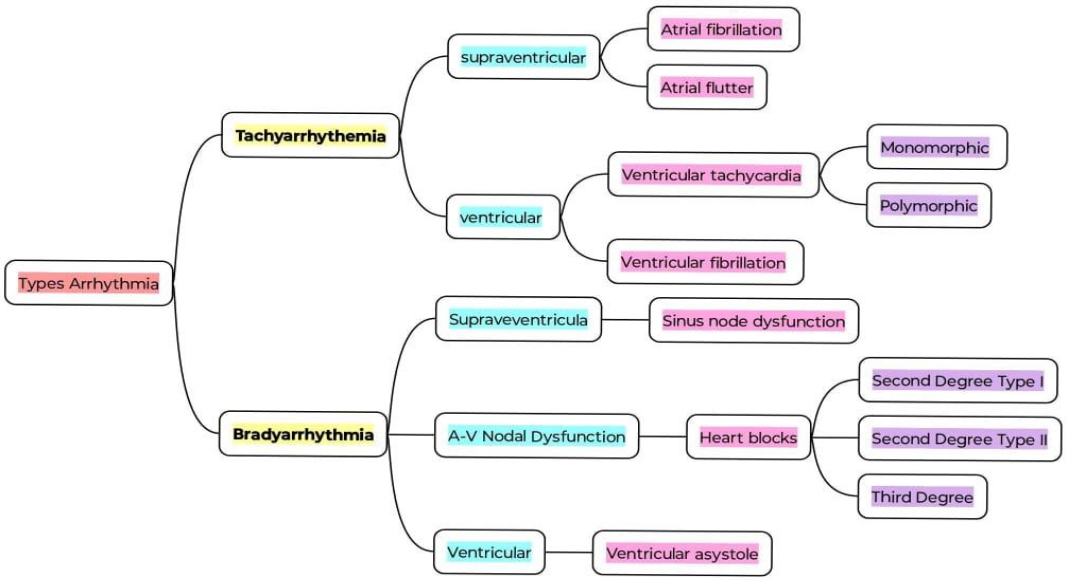


Fig. 1: Type of arrhythmia.

Etiology: Arrhythmias are disturbances in the heart's rhythm, arising from various etiological factors.

1. Age.
2. Congenital heart disease.
3. Underlying heart disease - atrial ischaemia, coronary heart disease, valve disease, and heart disease.
4. Excessive alcohol consumption.
5. Blood diseases - systemic or pulmonary.
6. Endocrine diseases - diabetes, pheochromocytoma and hyperthyroidism
7. Genetic factors

8. Hemodynamic stress - left ventricular pulmonary disease.

9. Front - Myocarditis and Pericarditis Conditions that cause inflammation, stress, injury, or ischemia that affect the condition of the heart can lead to atrial fibrillation.[5]

2. Ischemic heart disease: which has many causes from coronary heart disease, is the most common cause of arrhythmia. Myocardial ischemia leads to ventricular arrhythmia due to electrical insufficiency.[6]

3. Structural heart disease: Structural abnormalities, such as cardiomyopathies and heart valve disease, can impair electrical conduction.[7]

4. Electrical problems: Electrical problems, such as hyperkalemia or hypocalcemia, can seriously affect cardiac conduction and cause arrhythmias. This imbalance changes the intensity of myocardial activity and indicates abnormal rhythm.[8]

5. Effects on the autonomic nervous system: The autonomic nervous system plays an important role in controlling heart rhythm. Increased sympathetic tone or vagal stimulation can cause arrhythmias.[9]

Stages development of Arrhythmia

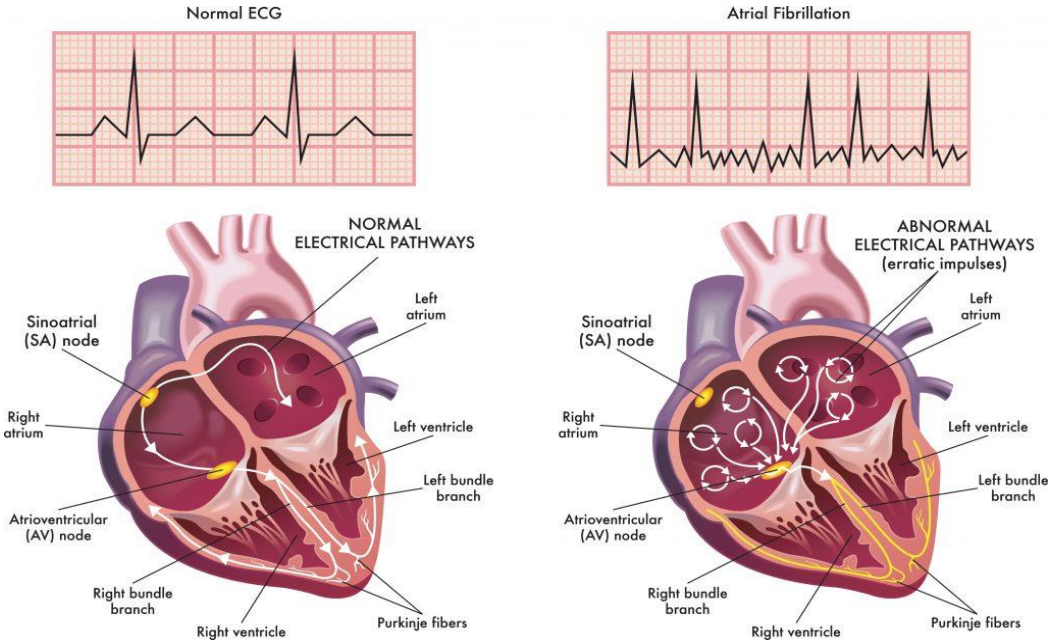


fig. 2: Electrical pathway.

1. Prearrhythmic Phase: Risk factors such as high blood pressure, diabetes and lifestyle choices lead to structural changes in the heart.[10]

2. Primary electrocardiogram:- Changes in the function of the ion channel and the myocardial bed lead to abnormalities and changes in conduction pathways.[11]

3. Intermittent Arrhythmia:- Arrhythmia periods are intermittent and self-limiting. Symptoms may include palpitations and dizziness.[12]

4. Persistent arrhythmias:- Arrhythmias become more frequent and may require medical intervention. This aspect greatly affects the quality of life.[13]

5. stable arrhythmia:- persistent arrhythmia that does not respond to treatment. Management focuses on symptom management and stroke prevention.[14]

6. complications and associated diseases:- Prolonged arrhythmias can cause complications such as heart failure, stroke and increased mortality.[15]

Treatment

1. Ashwagandha (Withania somnifera):Ashwagandha is decreasing cortisol levels, boosting parasympathetic activity, and supplying antioxidant defense. The bioactive components of the herb, especially withaferin A and withanolides, have exhibited anti-inflammatory, antioxidant, and antiarrhythmic properties.[16]

2. Hawthorn (Crataegus species): Hawthorn are bioactive component is flavonoids to enhance improving coronary circulation and stabilizes heart rhythms and prevents arrhythmias, especially in heart failure scenarios.[17]

3. Motherwort (Leonurus cardiaca): Motherwort is potential to control heart rate and rhythm. Its active ingredients, such as leonurine, have shown antiarrhythmic qualities by influencing calcium ion channels and enhancing blood circulation. Motherwort to reducing anxiety and stress.[18]

4. Garlic (Allium sativum): Garlic is widely recognized for its benefits to cardiovascular health, encompassing its capacity to lower blood pressure, decrease cholesterol levels, and enhance overall heart wellness and improving vascular performance.

5. Turmeric (Curcuma longa): Curcumin, the primary compound found in turmeric, has powerful anti-inflammatory and antioxidant capabilities. It may also aid in stabilizing the heart's electrical activity by modulating ion channels.[19]

ASHWAGANDHA

Introduction: In the traditional system of medicine, many diseases are treated with the help of plants and herbal products. There has been an interest in using herbal plants for their unique medicinal properties. Withania somnifera Dunal (Ashwagandha, WS) It is used in Ayurveda, the Indian system of medicine. "Indian ginseng" or "Indian winter cherry" are other names. The roots of this plant are called Rasayana, or the best adaptogen. Rasayana

means a herbal or mineral compound that promotes mental and physical well-being. Ayurveda is classified as Rasayana and is expected to promote physical and mental health. This plant has various properties, such as antioxidant, antistress, anti-inflammatory, immunomodulatory, antimicrobial, antidiabetic, and cardioprotective. reduction of reactive oxygen species, and affect the effects of anxiety and stress.[20]

Taxonomical classification

Fig. 3: Ashwagandha plant.

Synonyms: Sanskrit, Ashwagandha.
Kingdom: Plantae, Plants
Family: Solanaceae
Class: Dicotyledons
Species: somnifera Dunal
Genus: Withania
Division: Angiosperma
Order: Tubiflorae
Parts used: Whole plant, roots, leaves, stem, green berries, fruits, seeds, bark are used.[21]

Botanical description: Ashwagandha's botanical description (Withania somnifera) The Solanaceae family and plant can reach a height of two feet.The plant has uniformly shaped green or yellow and plump, whitish-brown roots are covered in bristles.

Geographical distribution: Geographical distribution Ashwagandha (Withania somnifera) subtropical regions of India. It is found mostly in northern India, especially in Mumbai, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Punjab and some mountainous areas like Himachal Pradesh.[22]

Phytochemical: Phytochemical compounds of Ashwagandha (Withania somnifera) Phytochemicals of Withania somnifera are of great interest to researchers. This species has been studied by various researchers and chemical groups such as steroid lactones, alkaloids, flavonoids, tannins have been extracted and identified. More than 13 alkaloids, 138 ba-anolides and many cytovindosides (one ba-anolide containing a sugar molecule at carbon 27) have been isolated from the aerial parts, roots and fruits of the Withania plant. Somnifera.[23]

Fig.4 Ashwagandha Roots.

Table 2: Macroscopic Characteristics of Withania somnifera L.[24]

Sr.No	Parameter	Observation
1	Shape	straight without branches, conical or cylindrical
2	Size	10-17 cm (length), 6-12 mm (width)
3	Surface	Smooth of outer surface with longitudinal wrinkles
4	Fractures	Short and uneven fractures
5	Other features	andy center with soft and hard pulp.

Chemical constituents: Ashwagandha contains many bioactive compounds that contribute to its healing effects

1. Alkaloids

i) Withaferin A - Reducing the inflammation and oxidative stress may help protect the heart from electrical disturbance that lead to arrhythmia.

ii) Withanine -The reducing anxiety and protect the heart rhythm.

iv) Tropin -protect heart.[25]

2. Saponins -Withaferin A: it is anti-inflammatory and heart disease and stabilizes heart function.[26]

3. Steroidal Lactones Withanolides: Known for their antioxidant effects, which can help mitigate oxidative stress on cardiac tissues.[27]

4. Flavonoids- Possess antioxidant properties that may protect cardiac cells from oxidative damage, thereby reducing the risk of arrhythmias.[28]

5. Triterpenes- Contribute to the overall cardioprotective effects by promoting heart health and reducing inflammation.

6. phenolic compounds- a vasodilatory agent that improves blood flow and reduces the risk of arrhythmia.[29]

Medicinal effects

1. Anti-inflammatory properties: Reducing inflammation can prevent tissue regeneration heart leading to arrhythmia.[30]

2. Vitamin effect: Fights oxidative stress, which is an important factor in the development of arrhythmia, thereby stabilizing the electrical activity of the heart.[31]

3. Reduce stress: Adaptive effects can reduce cortisol levels and reduce arrhythmic events caused by stress.[32]

4. Cardiovascular Health: Improves heart health by improving blood circulation and lowering blood pressure and reducing the risk of arrhythmia.[33]

5. Electrical modulation: Some compounds can directly affect ion channel activity and contribute to cardiac rhythms.[34]

Preparations of capsule

Preformulation studies

These studies evaluate the physicochemical properties, stability and compatibility of active substances and additives

1. Physicochemical properties

Explanation: Assessing the color, taste and smell of Ashwagandha powder helps to ensure quality and consistency

Solubility: Checking the solubility of Ashwagandha extract in different solvents is necessary to determine the correct formulation.[35]

2. Particle size analysis

Description: The particle size distribution will affect the life and stability of tires. Techniques such as laser diffraction can be used.[36]

3. Stability Method

Description: Evaluation of the stability of Ashwagandha extracts under different conditions of temperature and humidity ensures the accuracy of the active compounds over time.[37]

4. Compatibility studies

Description: Compatibility tests between Ashwagandha and supplements (using methods such as DSC and FTIR) will determine whether side effects may occur over time.[38]

5. Moisture content

Description: The moisture content of Ashwagandha powder is very important, because high humidity can cause microbial growth and degradation of nutrients.[39]

Formulation of capsule

1. Selection of active ingredients

Extracts: Standardized extracts of Ashwagandha root and leaf are often used, focusing on bioactive compounds such as anolides, alkaloids and saponins.

Excipients: Common additives are microcrystalline cellulose, magnesium stearate and gelatin for absorption.[40]

Capsule shell: hard gelatin capsule (size 00)

. Equipment

- capsule filling machine.
- residual filter.
- Oven and hot air.
- wait (80-100 screens).[41]

2. Preparation of Ashwagandha powder

1. Selection of raw materials: make use of premium dried roots.
2. Cotton: Use a machine and grind the roots into a fine powder.
3. Wait: Go through the waits to get ready.
4. Drying: If moist, use hot air oven at 40-50°C (Mishra et al., 2016).[42]

3. Construction of containers

1. Mix: Combine the ingredients with the ashwagandha powder.

The typical ratio:

- Ashwagandha powder: 80%

- MCC: 15%
- Magnesium stearate: 5%

2. Homogeneity check: Make sure to use the mortar and the pestle.[43]

4. Filling the capsule

1. Preparing the cap: separate the body and the cap.
2. Filling process: Fill the capsule using a capsule filling machine.
3. Close the tires: Place the covered tires in the back.[44]

Standardization of capsule

1. Active ingredient content: Quantification of enolides, the main active compounds in Ashwagandha.[45]
2. Quality Control: Implementing good manufacturing practices (GMP) consistently.[46]

-Weight difference: Consider the weight of the capsules.

-Separation Tests: Perform tests based on medical standards.

- Testing for active ingredients: Use HPLC to analyze microbial content
- Microbial testing: Ensure safety through microbial load testing.[47]

3. Chemical synthesis: identification and measurement of various chemical compounds.[48]
4. Microbial and heavy metal testing: ensure that the product is free of contamination.[49]
5. Durability testing: evaluating the durability of the product under different conditions.[50]

- Store the capsules under different conditions and evaluate the stability over time and test for strength and microbial content.

6. Biological studies: understanding the extent of absorption and use of active substances in the body.
7. Efficacy and safety evaluation: Conduct clinical studies to support health claims.[51]

Pharmacology effects on antiarrythmia

1. Cardiovascular health: Ashwagandha has shown positive effects on cardiovascular health by reducing stress and inflammation, that it helps lower blood pressure and improves heart rate variability (HRV), both of which are important for maintaining a normal rhythm.[52]
2. Electrical properties: Ashwagandha can affect the ion channel function in the heart cells, creating an electrical environment in the heart. This can reduce arrhythmias.[53]

3. Antioxidant Action:-The antioxidant effects of Ashwagandha can protect heart tissue from oxidative stress and reduce the risk of arrhythmias associated with myocardial ischemia.[54]

4. Modulation of inflammatory pathways: Ashwagandha's anti-inflammatory properties may play a role in reducing arrhythmia-related inflammatory mediators. Less inflammation contributes to a more stable heart.[55]

CONCLUSION

In Ashwagandha (Withania somnifera) has emerged as a promising herbal supplement with potential antiarrhythmic properties, and its well-known adaptogenic effects. The various bioactive compounds in Ashwagandha, particularly withanolides, are believed to exert cardioprotective effects through their antioxidant, anti-inflammatory, and neuroendocrine-modulating actions. ts ability to modulate the autonomic nervous system, reduce oxidative stress, and improve heart rate variability, all of which are critical in preventing and managing arrhythmias. Ashwagandha may provide benefits in supporting cardiovascular health and reducing arrhythmic events.

Ashwagandha capsules are typically standardized to contain specific concentrations of withanolides, but variations in the formulation, dosage, and bioavailability need ensure consistency and reliability in its effects.

REFERENCE

1. Yang, D., Deschênes, I., & Fu, J. (2022). Multilayer control of cardiac electrophysiology by microRNAs. Journal of Molecular and Cellular Cardiology, 166: 107–115. https://doi.org/10.1016/j.yjmcc.2022.02.007.
2. Kingma, J., Simard, C., & Drolet, B. (2023). Overview of Cardiac Arrhythmias and Treatment Strategies. Pharmaceuticals, 16(6): 844. https://doi.org/10.3390/ph16060844
3. Saber, M., & Abotaleb, M. (2022). Arrhythmia Modern Classification Techniques: A Review. DOI:10.54216/JAIM.010205, 1(2): 42–53. https://doi.org/10.54216/jaim.0102.
4. Saleh, Z.M. et al. (2023) ‘Anticancer and Antimicrobial Activity of Jatropha’s Leaves Extracts’, Egyptian Journal of Botany, 63(2): 621–634. Available at: https://doi.org/10.21608/ejbo.2023.162736.2137.
5. Khan, M. S., Khan, M. S., Hossain, M. H., Miraj, A. K. A., Rahaman, H. N. A., Rahman, M. M., Khandoker, M. I., Hoque, M. E., & Iqbal, M. Z. (2020). Atrial Fibrillation: Diagnosis, Treatment and Outcomes- A Case Study. Scholars Journal of Medical Case Reports, 8(12): 1012–1019. https://doi.org/10.36347/sjmcr.2020.v08i12.008

6. Josephson, M. E., Zimetbaum, P., Huang, D., Sauberman, R., Monahan, K. M., & Callans, D. S. (1997). Pathophysiologic substrate for sustained ventricular tachycardia in coronary artery disease. Japanese Circulation Journal, 61(6): 459–466. https://doi.org/10.1253/jcj.61.459
7. Kimura, A. (2011). Contribution of genetic factors to the pathogenesis of dilated cardiomyopathy - the cause of dilated cardiomyopathy: Genetic or acquired? (genetic-side) -. Circulation Journal, 75(7): 1756–1765. https://doi.org/10.1253/circj.cj-11-0368
8. Katz-Fishman, W., & Scott, J. (2012). Wage labor. The Wiley-Blackwell Encyclopedia of Globalization. https://doi.org/10.1002/9780470670590.wbeog943
9. Svorc, P. (2018). Introductory chapter: Autonomic nervous system - what we know about it. Autonomic Nervous System. https://doi.org/10.5772/intechopen.81026
10. Sequeira, V., & Maack, C. (2018a). Rebalancing protein phosphorylation in heart failure to prevent arrhythmias. European Journal of Heart Failure, 20(12): 1686–1689. https://doi.org/10.1002/ejhf.1315
11. No increase in heart failure rates with Alogliptin. (2015). Nature Reviews Cardiology, 12(5): 261–261. https://doi.org/10.1038/nrcardio.2015.53
12. Correction to: 2019 AHA/ACC/HRS focused update of the 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: A report of the american college of cardiology/american heart association task force on clinical practice guidelines and the heart rhythm society. (2019). Circulation, 140(6). https://doi.org/10.1161/cir.0000000000000719
13. Desteghe, L., & Heidbuchel, H. (2016). 'performance of handheld electrocardiogram devices to detect atrial fibrillation in a cardiology and Geriatric Ward Setting: Authors' response.' Europace. https://doi.org/10.1093/europace/euw237.
14. Catheter ablation for atrial fibrillation. (2012). New England Journal of Medicine, 366(11): 1058–1061. https://doi.org/10.1056/nejmc1200491
15. Al-Habeeb, W., & Al-Admawi, M. (2009). Managing patients with rapid atrial fibrillation and decompensated heart failure. Circulation: Heart Failure, 2(1): 71–71. https://doi.org/10.1161/circheartfailure.108.819540.
16. Thatte, U. M. (2017). Traditional Medicine: A Review of Work in India (2012-2017). Proceedings of the Indian National Science Academy. Part A, Physical Sciences, 95(0). https://doi.org/10.16943/ptinsa/2017/49236.
17. Kashif Maroof, Yim Yee Jin, Ching, & Siew Hua Gan. (2023). Medicinal Benefits of Propolis. 278–301. https://doi.org/10.1002/9781119113324.ch21.

18. Pope, C. A., Cohen, A. J., & Burnett, R. T. (2018). Cardiovascular Disease and Fine Particulate Matter. Circulation Research, 122(12): 1645–1647. https://doi.org/10.1161/circresa.
19. MARTINS, P., DE, M., ROBERTO, O., CAMATARI, S., OLIVEIRA, M., & FABIANA ANDRÉA MOURA. (2023). Curcumin in inflammatory bowel diseases: Cellular targets and molecular mechanisms. Biocell, 47(11): 2547–2566. https://doi.org/10.32604/biocell.2023.043253.
20. Thakur, S., Kaurav, H., & Chaudhary, G. (2021). A REVIEW ON ASHWAGANDHA (WITHANIA SOMNIFERA): MIND AND BODY REJUVENATOR. International Journal of Research in Ayurveda and Pharmacy, 12(2): 132–139. https://doi.org/10.7897/2277-4343.120263
21. Khare, C. P., & Vikram Naharwar, A. (2020a). Ashwagandha (Withania Somnifera (L.) Dunal): A Scientific Review with respect to Ayurvedic Perspectives. Annals of Phytomedicine: An International Journal, 9(2). https://doi.org/10.21276/ap.2020.9.2.11
22. Thakur, S., Kaurav, H., & Chaudhary, G. (2021). A REVIEW ON ASHWAGANDHA (WITHANIA SOMNIFERA): MIND AND BODY REJUVENATOR. International Journal of Research in Ayurveda and Pharmacy, 12(2): 132–139. https://doi.org/10.7897/2277-4343.120263
23. Thakur, S., Kaurav, H., & Chaudhary, G. (2021). A REVIEW ON ASHWAGANDHA (WITHANIA SOMNIFERA): MIND AND BODY REJUVENATOR. International Journal of Research in Ayurveda and Pharmacy, 12(2): 132–139. https://doi.org/10.7897/2277-4343.120263
24. Thumar, Mayuri M., et al. "Pharmacognostic evaluation on four commonly used antianemic plants." Journal of Integrated Health Sciences, July 2022; 10(1): 53–59, https://doi.org/10.4103/jihs.jihs_12_22..
25. Dhanani, T., Shah, S., Gajbhiye, N. A., & Kumar, S. (2017). Effect of extraction methods on yield, phytochemical constituents and antioxidant activity of Withania somnifera. Arabian Journal of Chemistry, 10: S1193–S1199. https://doi.org/10.1016/j.arabjc.2013.02.015
26. Anand, U., Tudu, C. K., Nandy, S., Sunita, K., Tripathi, V., Loake, G. J., Dey, A., & Proćków, J. (2022). Ethnodermatological use of medicinal plants in India: From ayurvedic formulations to clinical perspectives – A review. Journal of Ethnopharmacology, 284(1): 114744. https://doi.org/10.1016/j.jep.2021.114744

27. Srivastava, A., Srivastava, P., Pandey, A., Khanna, V. K., & Pant, A. B. (2019). Phytomedicine. New Look to Phytomedicine, 625–655. https://doi.org/10.1016/b978-0-12-814619-4.00025-2.
28. Das, U., Ray, R. C., & Bishnupriya Hansdah. (2022). Ethnomedicinal and biological activities of tropical mahua (Madhuca species) – A comprehensive review. Annals of Tropical Research, 67–88. https://doi.org/10.32945/atr4425.2022
29. Tilak-Jain, J. A., & Devasagayam, T. P. A. (2006). Cardioprotective and Other Beneficial Effects of Some Indian Medicinal Plants. Journal of Clinical Biochemistry and Nutrition, 38(1): 9–18. https://doi.org/10.3164/jcbn.38.9.
30. Bhattacharya, Riya, et al. Bioelectricity Production and Bioremediation Potential of Withania Somnifera, 6 Nov. 2023. https://doi.org/10.21203/rs.3.rs-3014220/v2.
31. Gupta, Kanika, and Rimpy Sharma. "Review on pharmacological potential of Withania Somnifera." International Journal of Advances in Scientific Research and Engineering, 2019; 5(11): 53–57. https://doi.org/10.31695/ijasre.2019.33584
32. Archana, R, and A Namasivayam. "Antistressor effect of Withania Somnifera." Journal of Ethnopharmacology, Jan. 1998; 64(1): 91–93. https://doi.org/10.1016/s0378-8741(98)00107-x.
33. Rohit, Jain, et al. "Phytochemistry, pharmacology, and Biotechnology of Withania Somnifera and Withania Coagulans: A Review." Journal of Medicinal Plants Research, 25 Oct. 2012; 6(41): 5388–5399. https://doi.org/10.5897/jmpr12.704.
34. Lopresti, Adrian L., and Stephen J. Smith. "Ashwagandha (Withania Somnifera) for the treatment and enhancement of mental and physical conditions: A systematic review of human trials." Journal of Herbal Medicine, Aug. 2021; 28: 100434. https://doi.org/10.1016/j.hermed.2021.100434.
35. Jana, Snehasis. "Physicochemical, thermal and spectroscopic characterization of the energy of consciousness healing treated Withania somnifera (ashwagandha) root extract." Journal of Natural & Ayurvedic Medicine, 6 Jan. 2021; 5(1): 1–10. https://doi.org/10.23880/jonam-16000296.)
36. Carstensen, J.T., and Mahendra Patel. "Particle-size distributions of milled granulations and powders." Journal of Pharmaceutical Sciences, Sept. 1974; 63(9): 1494–1495. https://doi.org/10.1002/jps.2600630943.)
37. Ramya Kuber, B., et al. "Pharmacognostic and pharmacological evaluation of withania somnifera herbal formulations." Journal of Pharmaceutical Research, 1 Oct. 2004; 3(4): 57. https://doi.org/10.18579/jpcrkc/2004/3/4/79690.

38. Purohit, Abhilasha, and Ashok Purohit. "ELTROXIN like mimic action of Withania somnifera leaf extract in hypothyroid-induced rats." Asian Journal of Pharmaceutical and Clinical Research, 7 Nov. 2018; 11(11): 280. https://doi.org/10.22159/ajpcr.2018.v11i11.27424.
39. Khawas, Prerna, and Sankar Chandra Deka. "Moisture sorption isotherm of underutilized culinary banana flour and its antioxidant stability during storage." Journal of Food Processing and Preservation, 14 Sept. 2016; 41(4). https://doi.org/10.1111/jfpp.13087.
40. Kumar, Brijesh, et al. "Withania ethno and Phytopharmacological Review." Phytochemistry of Withania Somnifera, 1 Nov. 2021; 1–30. https://doi.org/10.1201/9781003186274-1.
41. Kaur, Darshan. "Formulation and evaluation of hard gelatin capsules containing Bacopa monnieri." INTERNATIONAL JOURNAL OF PHARMACEUTICAL EDUCATION AND RESEARCH (IJPER), 8 Jan. 2020; 1(2): 33–37. https://doi.org/10.37021/ijper.v1i2.2.
42. Mishra et al., 2016).(Khogta, Saloni, et al. "Herbal nano-formulations for topical delivery." Journal of Herbal Medicine, Apr. 2020; 20: 100300. https://doi.org/10.1016/j.hermed.2019.100300.
43. Nováková, Lucie, et al. "Ultra-high performance liquid chromatography." Liquid Chromatography, 2017; 719–769. https://doi.org/10.1016/b978-0-12-805393-5.00029-4.
44. Tiwari, Vinod K., et al. "Cu-catalyzed click reaction in carbohydrate chemistry." Chemical Reviews, 22 Jan. 2016; 116(5): 3086–3240. https://doi.org/10.1021/acs.chemrev.5b00408.
45. Pandey, Ravindra Kumar, et al. "Standardization of Herbal Drugs." Fingerprinting Analysis and Quality Control Methods of Herbal Medicines, 3 July 2018; 121–152. https://doi.org/10.1201/b22160-14.
46. Połumackanycz, Milena, et al. "Ashwagandha (Withania somnifera L.) - the plant with proven health-promoting properties." Farmacja Polska, 28 Sept. 2020; 76(8): 442–447. https://doi.org/10.32383/farmpol/127824.
47. Krup, V., Hegde, P. L., A, H., & Altaf, M. (2014). Anti-hyperglycemic effect of root powder of Coccinia grandis L. Voigt with special reference to MADHUMEHA: A pilot study. International Journal of Research in Ayurveda & amp; Pharmacy, 5(5): 605–608. https://doi.org/10.7897/2277-4343.055123.

48. Deupa, Hema, and Priyanka Shankar. “Efficacy of herbal medicines in management of polycystic ovarian syndrome: A scoping review.” International Journal of Ayurvedic Medicine, 7 Jan. 2024; 14(4): 901–911. https://doi.org/10.47552/ijam.v14i4.4212.
49. Kalra, Rishu, and Nutan Kaushik. “Withania somnifera (Linn.) Dunal: A review of Chemical and pharmacological diversity.” Phytochemistry Reviews, 3 Apr. 2017; 16(5): 953–987. https://doi.org/10.1007/s11101-017-9504-6.
50. Kaur, N., & Sharma, S. (2022). Formulation, evaluation, and stability testing of polyherbal antidiabetic capsules. International Journal of Pharmaceutical Investigation, 13(1): 173–178. https://doi.org/10.5530/223097131753.
51. Sharma, I. (2017). Clinical studies with Ayurvedic formulations-a practitioner’s preview. Journal of Natural & Ayurvedic Medicine, 1(1). https://doi.org/10.23880/jonam-16000106.
52. Dhuley, J. N. (2000). Retracted: Adaptogenic and cardioprotective action of ashwagandha in rats and frogs. Journal of Ethnopharmacology, 70(1): 57–63. https://doi.org/10.
53. Natarelli, N., Gahoonia, N., Maloh, J., & Sivamani, R. K. (2023). Clinical efficacy of topical or oral soy supplementation in dermatology: A systematic review. Journal of Clinical Medicine, 12(12): 4171. https://doi.org/10.3390/jcm12124171.
54. Clementino, A. R., Marchi, C., Pozzoli, M., Bernini, F., Zimetti, F., & Sonvico, F. (2021). Anti-inflammatory properties of statin-loaded biodegradable lecithin/chitosan nanoparticles: A step toward nose-to-brain treatment of Neurodegenerative Diseases. Frontiers in Pharmacology, 12. https://doi.org/10.3389/fphar.2021.716380.
55. Remme, C. A. (2022). Reply to karadeniz et al.—could branched-chain amino acids be a new landmark in metabolic syndrome and cardiac arrhythmias? Canadian Journal of Cardiology, 38(8): 1327. https://doi.org/10.1016/j.cjca.2022.04.018).