Journal of Dravyaguna and Bhaishajya Vigyan

P-ISSN: 3078-7769
E-ISSN: 3078-7777
JDBV 2024; 1(1): 13-16
www.dravyagunajournal.com
Received: 04-12-2023
Accepted: 11-01-2024

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Antioxidant and anti-inflammatory properties of herbal extracts in ayurvedic formulations

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DOI: https://doi.org/10.33545/dravyaguna.2024.v1.i1.A.4

Abstract
Chronic diseases, primarily driven by oxidative stress and inflammation, have become increasingly prevalent and require effective management strategies. This review discusses Ayurvedic herbal extracts, focusing on their antioxidant and anti-inflammatory properties and their therapeutic potential within traditional formulations. Ayurvedic medicine, an ancient Indian healing system, has long incorporated plants with natural antioxidant and anti-inflammatory components to treat conditions linked to oxidative and inflammatory damage. Key herbs, including *Curcuma longa* (turmeric), *Withania somnifera* (ashwagandha), *Emblica officinalis* (amla), *Zingiber officinale* (ginger), and *Ocimum sanctum* (tulsi), are explored for their bioactive compounds and mechanisms that confer these protective effects. Further, the review addresses the clinical efficacy of common Ayurvedic formulations, such as *Chyawanprash* and *Triphala*, while examining the challenges of standardization and potential for integration with modern therapeutic approaches. This synthesis underscores the significant role of Ayurveda in chronic disease prevention and therapeutic support, with recommendations for future research to validate and expand the understanding of these herbs.

Keywords: Ayurveda, herbal extracts, antioxidants, anti-inflammatory, bioactive compounds, chronic disease, traditional medicine

1. Introduction
Chronic diseases, including cardiovascular disorders, diabetes, neurodegenerative conditions, and certain cancers, are among the leading causes of morbidity and mortality worldwide. These diseases share common pathological features, with oxidative stress and chronic inflammation playing central roles in their initiation, progression, and exacerbation. Oxidative stress arises when there is an imbalance between reactive oxygen species (ROS) production and the body's antioxidant defenses, leading to cellular damage, lipid peroxidation, DNA mutation, and ultimately cellular dysfunction. Chronic inflammation, often triggered by oxidative stress, further exacerbates tissue injury through the activation of immune cells and the release of inflammatory cytokines, creating a vicious cycle of damage that accelerates disease progression. In recent years, there has been an increasing interest in natural remedies that can mitigate oxidative and inflammatory damage due to their promising safety profile and reduced side effects compared to synthetic drugs. Ayurveda, an ancient system of traditional medicine rooted in India, has long relied on plant-based formulations to treat conditions associated with oxidative and inflammatory stress. Ayurveda views health as a balanced state among the three biological energies or Doshas—Vata, Pitta, and Kapha—which are responsible for maintaining physiological harmony within the body. When these Doshas are imbalanced, they are believed to create an internal environment that predisposes individuals to diseases, including those stemming from oxidative and inflammatory damage. Ayurvedic medicine uses various herbs and formulations, referred to as Rasayana therapies, to restore this balance, boost immunity, and prevent disease. Rasayana herbs, such as *Emblica officinalis* (amla), *Withania somnifera* (ashwagandha), *Curcuma longa* (turmeric), and *Zingiber officinale* (ginger), are traditionally used to rejuvenate the body and mind, reduce the buildup of metabolic waste, and maintain cellular health. Modern scientific research has increasingly validated these practices, showing that many Ayurvedic herbs contain bioactive compounds with potent antioxidant and anti-inflammatory properties. These compounds, including polyphenols, flavonoids, terpenoids, and alkaloids, are capable

of scavenging free radicals, enhancing endogenous antioxidant enzymes, and modulating inflammatory pathways, such as the NF-κB and MAPK signaling pathways. As a result, these herbs offer dual protection against oxidative and inflammatory damage, providing a natural approach to managing chronic diseases.

1.1 Main Objectives

The main objectives of this paper are to;

1. Review the antioxidant and anti-inflammatory properties of key Ayurvedic herbs.
2. Explore the bioactive compounds and mechanisms underlying these effects.

2. Ayurvedic Understanding of Antioxidant and Anti-inflammatory Actions

In Ayurvedic medicine, health is conceptualized as a state of balance among three fundamental biological energies, or Doshas—Vata, Pitta, and Kapha—which govern physiological processes and influence physical and mental characteristics. According to Ayurveda, disease arises when these Doshas fall out of balance, with oxidative stress and inflammation often seen as manifestations of such an imbalance. Oxidative damage and chronic inflammation are considered detrimental because they disturb the body's natural equilibrium, accumulating metabolic waste (Ama) and generating conditions favorable to disease. Ayurvedic Rasayana therapy, which consists of herbs and formulations aimed at rejuvenating and preserving health, has traditionally addressed oxidative and inflammatory disorders. The practice views antioxidant and anti-inflammatory actions as fundamental in detoxifying the body, boosting immunity, and promoting longevity. Ancient Ayurvedic texts, such as the *Charaka Samhita* and *Sushruta Samhita*, mention specific Rasayana herbs known for their rejuvenative and disease-preventing qualities. These include *Amalaki* (Emblica officinalis), *Haritaki* (Terminalia chebula), *Guduchi* (Tinospora cordifolia), *Ashwagandha* (Withania somnifera), and *Turmeric* (Curcuma longa), which are still extensively used in Ayurvedic medicine for their multifaceted health benefits. Modern pharmacological research has validated these practices, discovering that these herbs contain bioactive compounds with potent antioxidant and anti-inflammatory effects, providing mechanistic insights into their efficacy. Ayurvedic literature describes antioxidant activity as the ability of certain herbs to eliminate Ama (toxins) and enhance the body's resistance to degeneration. In the Ayurvedic view, Rasayana herbs act by building Ojas, a concept roughly equated with vitality and immunity in modern terms. Building Ojas is considered critical to maintaining cellular health and preventing tissue damage associated with oxidative stress. Studies have shown that Rasayana herbs contain high levels of antioxidants like polyphenols, flavonoids, tannins, and ascorbic acid, which help neutralize reactive oxygen species (ROS) and enhance endogenous antioxidant systems. For instance, *Amalaki* (Emblica officinalis), a Rasayana herb with a prominent role in Ayurvedic formulations like *Chyawanprash*, contains high levels of vitamin C and ellagic acid, which have been shown to protect cells against oxidative DNA damage. Studies on *Amalaki* indicate that it significantly increases antioxidant enzyme activity in the liver, suggesting that it can stimulate the body's natural antioxidant defense mechanisms. Inflammation in Ayurveda is closely associated with an imbalance in the Pitta Dosha, which is thought to cause excessive heat, leading to swelling, pain, and tissue breakdown. Herbs with Tikta (bitter) and Katu (pungent) Ras (taste) are believed to alleviate these symptoms by pacifying Pitta and eliminating toxins. These herbs are traditionally used to manage conditions such as arthritis, respiratory infections, and skin inflammations. For example, *Turmeric* (Curcuma longa), known for its anti-inflammatory properties, has been described in Ayurvedic texts as a key ingredient in formulations targeting inflammation-related disorders. Modern studies reveal that turmeric's principal compound, curcumin, can inhibit inflammatory pathways, such as the nuclear factor-kappa B (NF-κB) and cyclooxygenase-2 (COX-2) pathways, responsible for cytokine production and inflammation. These findings support the Ayurvedic notion that turmeric can balance Pitta by reducing inflammatory responses. In addition to individual herbs, Ayurvedic formulations often combine multiple herbs to harness their synergistic effects on oxidative stress and inflammation. For instance, *Triphala*, a blend of three fruits—*Amalaki* (Emblica officinalis), *Bibhitaki* (Terminalia bellirica), and *Haritaki* (Terminalia chebula)—is widely used in Ayurveda to cleanse and detoxify. Studies on *Triphala* have demonstrated its strong antioxidant and anti-inflammatory effects, attributed to its high polyphenolic content. In experimental studies, *Triphala* has been shown to inhibit lipid peroxidation and increase levels of antioxidant enzymes, such as superoxide dismutase (SOD) and glutathione peroxidase, in the liver and other organs. Furthermore, it reduces pro-inflammatory cytokines, supporting the Ayurvedic principle of balancing Doshas to prevent inflammatory diseases.

Ayurvedic understanding of antioxidant and anti-inflammatory actions is also influenced by the concept of Dhatu (tissue) preservation, which emphasizes maintaining the integrity of various bodily tissues, including Rasa (plasma), Rakta (blood), and Majja (bone marrow). Herbs like *Ashwagandha* and *Guduchi*, known as Dhatu nourishers, are believed to protect tissues from degeneration. Research has shown that *Ashwagandha* (Withania somnifera) not only reduces oxidative damage by neutralizing free radicals but also exerts anti-inflammatory effects by downregulating pro-inflammatory markers, such as IL-1β and TNF-α. Clinical studies indicate that *Ashwagandha* supplementation can improve inflammatory conditions by modulating these cytokines, thus supporting the Ayurvedic principle of preserving Dhatu to promote resilience against stress and inflammation. Ayurvedic medicine offers a holistic approach to managing oxidative and inflammatory stress, drawing on the principles of Dosha balance, Rasayana therapy, and Dhatu preservation. This understanding aligns with findings from modern pharmacological studies, which indicate that Ayurvedic herbs contain bioactive compounds that act as potent antioxidants and anti-inflammatory agents. Through detoxification, immune support, and tissue preservation, these herbs contribute to maintaining health and longevity, making Ayurvedic formulations an effective natural approach to disease prevention and management. The Ayurvedic perspective provides valuable insights into how these herbs can complement modern treatments, offering a

balanced approach to oxidative and inflammatory disease management.

3. Mechanisms of Antioxidant and Anti-inflammatory Actions in Ayurvedic Herbs

The bioactive compounds in Ayurvedic herbs are central to their antioxidant and anti-inflammatory effects. These mechanisms involve several pathways:

3.1 Antioxidant Mechanisms: Antioxidant compounds scavenge free radicals, inhibit lipid peroxidation, and enhance endogenous antioxidant defenses. Compounds such as polyphenols, flavonoids, and carotenoids contribute to the neutralization of reactive oxygen species (ROS). They also upregulate antioxidant enzymes, including superoxide dismutase (SOD), catalase, and glutathione peroxidase, to fortify cellular defense mechanisms.

3.2 Anti-inflammatory Mechanisms: Ayurvedic herbs exert anti-inflammatory effects by inhibiting the expression of inflammatory mediators like cyclooxygenase-2 (COX-2), tumor necrosis factor-alpha (TNF-α), and interleukins (e.g., IL-1β, IL-6). They also modulate nuclear factor-kappa B (NF-κB) and mitogen-activated protein kinase (MAPK) pathways, which play crucial roles in inflammation. Such actions help mitigate inflammation-related tissue damage and restore cellular integrity.

4. Ayurvedic Herbs with Antioxidant and Anti-inflammatory Properties

4.1 Turmeric (*Curcuma longa*)

Turmeric is renowned in both traditional and modern medicine for its therapeutic properties, attributed primarily to curcumin, its principal bioactive compound. Curcumin demonstrates powerful antioxidant activity by neutralizing free radicals and enhancing the body's antioxidant defenses. It also inhibits lipid peroxidation, which reduces oxidative stress at the cellular level.

Curcumin's anti-inflammatory effects are mediated through inhibition of the COX-2 enzyme and suppression of the NF-κB pathway, which are essential in cytokine production and inflammation. Clinical studies have shown that curcumin supplementation can alleviate symptoms in conditions such as rheumatoid arthritis and inflammatory bowel disease, supporting its role as an anti-inflammatory agent.

4.2 Ashwagandha (*Withania somnifera*)

Ashwagandha, or Indian ginseng, is traditionally classified as a Rasayana and used to boost vitality and reduce stress. Its bioactive components, including withaferin A and withanolides, possess strong antioxidant properties, reducing oxidative damage by neutralizing ROS. Ashwagandha enhances SOD and catalase activity, further bolstering cellular defense against oxidative stress.

The herb's anti-inflammatory properties are attributed to its ability to suppress pro-inflammatory cytokines, including TNF-α and IL-6. Studies have documented Ashwagandha's effectiveness in reducing inflammatory markers in stress-related disorders, demonstrating its dual action on antioxidant and anti-inflammatory pathways.

4.3 Amla (*Emblica officinalis*)

Amla, rich in vitamin C, tannins, and flavonoids, is one of the most potent antioxidants in Ayurvedic medicine. Vitamin C scavenges ROS and enhances the activity of glutathione, a critical endogenous antioxidant. Amla also prevents lipid peroxidation and protects DNA from oxidative damage, promoting cellular longevity and reducing the risk of chronic diseases.

Amla's anti-inflammatory action is achieved through the inhibition of inflammatory cytokines and reduction in leukocyte migration. It has shown efficacy in reducing markers of inflammation in conditions like arthritis, demonstrating its potential as a natural anti-inflammatory agent.

4.4 Ginger (*Zingiber officinale*)

Ginger contains bioactive compounds such as gingerol and shogaol, which exhibit substantial antioxidant effects by neutralizing free radicals and preventing lipid peroxidation. These compounds also stimulate the activity of antioxidant enzymes, enhancing the body's resilience against oxidative stress.

The anti-inflammatory properties of ginger are attributed to its inhibition of COX-2 and modulation of TNF-α and IL-6 levels. Ginger has been shown to reduce pain and inflammation in arthritis and muscle pain, supporting its use in Ayurvedic pain management.

4.5 Tulsi (*Ocimum sanctum*)

Tulsi, or holy basil, is regarded as an adaptogen with antioxidant and anti-inflammatory properties. Eugenol and ursolic acid, the primary bioactive compounds, protect cells against oxidative damage and enhance endogenous antioxidant defenses.

Tulsi reduces inflammation by suppressing the NF-κB pathway and inhibiting pro-inflammatory cytokines. It has been used in Ayurveda for respiratory and skin inflammations, with studies demonstrating its efficacy in reducing inflammatory markers in various models.

5. Ayurvedic Formulations and Their Efficacy

In Ayurvedic practice, combinations of herbs are formulated to synergize their individual properties, thereby enhancing their therapeutic efficacy. Formulations such as *Chyawanprash*, *Triphala*, and *Dashmoolarista* have gained popularity due to their potent antioxidant and anti-inflammatory actions.

Chyawanprash combines herbs like amla, ashwagandha, and pippali, which collectively reduce oxidative stress and inflammation. Clinical studies support its immune-modulatory properties, making it a popular formulation for enhancing immunity and managing chronic inflammatory conditions.

Triphala, a blend of three fruits (*Amalaki*, *Bibhitaki*, and *Haritaki*), is rich in tannins and flavonoids, which confer antioxidant effects. It is traditionally used to detoxify the body, reduce inflammation, and enhance gut health.

Dashmoolarista, containing ten root herbs, exhibits strong anti-inflammatory and antioxidant properties, making it effective in managing respiratory and musculoskeletal conditions. The formulation's efficacy in reducing inflammation and oxidative damage has been supported by various studies.

6. Challenges and Future Directions

One of the primary challenges in the clinical application of Ayurvedic herbs is the standardization of extracts. Variability in the concentration of bioactive compounds

across different plant sources can lead to inconsistent therapeutic effects. Advancements in phytochemistry and pharmacokinetics are needed to create standardized extracts with reproducible effects.

Integrating Ayurvedic formulations into conventional medicine presents an opportunity to enhance chronic disease management. Collaborative research that explores Ayurvedic and Western approaches can provide a comprehensive understanding of herbal pharmacology and its therapeutic potential. Future research should prioritize clinical trials with standardized formulations and investigate the synergistic effects of herb combinations in Ayurvedic formulations.

7. Conclusion

The antioxidant and anti-inflammatory properties of Ayurvedic herbs hold significant promise in the prevention and management of chronic diseases. Herbs such as turmeric, ashwagandha, amla, ginger, and tulsi offer multi-targeted therapeutic effects, supported by bioactive compounds that modulate oxidative and inflammatory pathways. Ayurvedic formulations like *Chyawanprash* and *Triphala* exemplify the synergy achieved through herbal combinations, enhancing the therapeutic potential beyond individual herbs. Although promising, further research is essential to standardize these formulations, validate their efficacy, and explore their integration with conventional treatments for holistic patient care.

8. References

1. Ahmed M, Hossain M, Rahman MS. Phytochemical screening and antioxidant properties of various herbal extracts from Bangladesh. Bangladesh J Bot. 2020;49(2):223-230.
2. Alam ASM, Biswas R, Hossain MS. Anti-inflammatory and antioxidant properties of *Centella asiatica* in traditional Bangladeshi medicine. J Ethnopharmacol. 2021;267:113610.
3. Alam MN, Bristi NJ, Rafiquzzaman M. Review on in vivo and in vitro methods evaluation of antioxidant activity. Saudi Pharm J. 2013;21(2):143-152.
4. Das A, Sarkar C, Mandal S. Pharmacological effects of *Withania somnifera* in Ayurvedic and traditional Bangladeshi medicine. Asian J Tradit Med. 2019;14(4):101-115.
5. Farjana T, Shimu MSS, Ahmed R. Comparative analysis of antioxidant properties of medicinal plants used in Bangladeshi traditional medicine. Dhaka Univ J Pharm Sci. 2020;19(1):15-23.
6. Islam MS, Hossain MS, Rahman MM. Evaluating anti-inflammatory activities of *Curcuma longa* extract in traditional medicinal practices. Bangladesh Pharm J. 2022;25(1):10-18.
7. Jahan IA, Uddin N, Rahmatullah M. Medicinal uses of *Emblica officinalis* and its applications in Bangladeshi and Ayurvedic medicine. J Med Plants Stud. 2011;2(3):45-52.
8. Kabir MS, Khan MM. Comparative study on the antioxidant activity of *Ocimum sanctum* extracts. Bangladesh J Med Plant Res. 2021;8(1):30-37.
9. Khatun MT, Islam MT, Hasan MA. Phytochemistry and medicinal applications of ginger (*Zingiber officinale*) in Bangladeshi traditional medicine. J Med Plants Res. 2018;12(13):269-275.
10. Mahbub S, Haque ME. Evaluation of the anti-inflammatory properties of *Terminalia chebula* extracts in Bangladeshi folk medicine. Int J Med Plant Res. 2021;5(4):123-132.
11. Mondal MM, Alam AS. Herbal formulations with antioxidant properties in traditional Bangladeshi medicine: A review of therapeutic benefits. Bangladesh J Plant Med. 2019;27(3):217-225.
12. Nasrin T, Chowdhury MS, Nahar L. In vitro antioxidant properties of *Tinospora cordifolia* used in Ayurvedic and Bangladeshi traditional medicine. Bangladesh J Bot. 2016;45(4):489-495.
13. Rahman A, Ali M. Traditional uses of Ashwagandha in Bangladesh: An overview. J Ethnopharmacol. 2020;250:112367.
14. Rahman MM, Hasan MM, Ahmed R. Ethnopharmacological use of turmeric (*Curcuma longa*) in Bangladesh for its anti-inflammatory properties. Bangladesh J Med Biol Sci. 2021;18(2):101-108.
15. Rashid M, Hossain MS, Sultana S. Study of the antioxidant activity of *Ocimum sanctum* in traditional Bangladeshi medicine. J Med Plant Res. 2022;10(7):181-190.
16. Roy M, Islam MS, Begum S. Traditional applications of *Emblica officinalis* as an antioxidant in Bangladeshi medicine. Bangladesh J Tradit Med. 2020;16(1):49-56.
17. Sarker MK, Uddin R. Therapeutic potential of *Withania somnifera* in inflammatory diseases: A review based on Bangladeshi traditional practices. Asian J Plant Sci. 2018;17(5):242-251.
18. Shimu MSS, Alam S, Rahman R. Anti-inflammatory activities of *Terminalia chebula* in Bangladeshi folk medicine. Bangladesh J Nat Med. 2022;9(2):102-108.