Review Article

Review of Amalaki (Emblica officinalis) for Its Pharmacological Properties: A Systematic Review

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Abstract

Background: Amalaki (Emblica officinalis), also known as Indian Gooseberry, is a widely used Ayurvedic fruit with significant pharmacological properties. This systematic review aims to synthesize the evidence regarding its pharmacological benefits based on ancient Ayurvedic literature and modern scientific research.

Methods: A systematic review of the literature was conducted by searching databases such as PubMed, Scopus, and Google Scholar. Studies on the pharmacological properties of Amalaki published from inception until 2023 were included. Articles were selected based on inclusion criteria such as relevance to pharmacology, full-text availability, and focus on either Ayurvedic or modern medicinal properties of Amalaki. The risk of bias in each study was assessed using Cochrane's risk of bias tools.

Results: The search yielded 52 studies, of which 16 met the inclusion criteria. Amalaki possesses a wide range of pharmacological properties, including anti-inflammatory, anticancer, hepatoprotective, and immunomodulatory effects. Traditional Ayurvedic literature also highlights its tridoshghna (balancing all three doshas), rasayana (rejuvenating), and vaysthapan (anti-aging) properties.

Conclusion: Both ancient and modern evidence support the wide range of therapeutic benefits of Amalaki. Further clinical studies are warranted to explore its mechanisms and therapeutic potential in greater detail.

Keywords: Amalaki, Emblica officinalis, Indian gooseberry, pharmacological properties, Ayurveda, systematic review

Introduction

Rationale

Amalaki (Emblica officinalis), a key Ayurvedic plant, has been extensively used in traditional Indian medicine for its numerous therapeutic properties.[1-4] In Ayurveda, it is classified as a tridoshghna (balancing all three doshas) and is mentioned in classical texts such as Charaka Samhita and Sushruta Samhita. Given the recent interest in plant-based medicines and the growing body of scientific literature on Amalaki, a systematic review synthesizing its pharmacological properties is timely and necessary.[5-9]

Objectives

The objective of this systematic review is to summarize the pharmacological properties of Amalaki as described in both Ayurvedic texts and modern scientific research. We aim to assess its potential benefits for various diseases and identify gaps for future research.

Methods

EligibilityCriteria

Studies were included if they met the following criteria:

- Investigated the pharmacological properties of Amalaki or its extracts.
- Published in peer-reviewed journals.
- Focused on either traditional Ayurvedic uses or modern pharmacological research.
- Available in full text in English.

Exclusion criteria included:

- Studies not focused on pharmacological properties.
- Incomplete or inaccessible articles.

Information Sources

The following databases were searched: PubMed, Scopus, and Google Scholar. The search included articles published up to 2023, with no restrictions on language. Additional articles were identified through cross-references from the selected studies.

Search Strategy

A systematic search strategy was developed using the following keywords: “Amalaki,” “Emblica officinalis,” “Indian gooseberry,” “Ayurvedic medicine,” and

"pharmacological properties." Boolean operators were used to combine terms, and searches were tailored for each database.

Study Selection

The search results were independently screened by two reviewers. Disagreements were resolved by a third reviewer. Full texts of potentially eligible studies were retrieved and assessed against the inclusion criteria.

Data Collection Process

Data were extracted using a standardized data extraction form. Extracted information included the study design, sample size, pharmacological activity, outcomes, and relevant conclusions.

Risk of Bias in Individual Studies

The risk of bias was assessed using Cochrane's Risk of Bias tools for randomized trials and non-randomized studies. This included domains such as selection bias, performance bias, detection bias, and reporting bias.

Results

Study Selection

A total of 52 articles were identified from the initial database search. After removing duplicates and screening titles and abstracts, 30 full-text articles were assessed for eligibility, and 16 articles were included in the final review.

Study Characteristics

The included studies examined various pharmacological effects of Amalaki, including antioxidant, immunomodulatory, anticancer, anti-inflammatory, hepatoprotective, and gastroprotective properties. Studies ranged from in vitro experiments, animal models, and clinical trials.

Risk of Bias in Studies

Most studies showed a low to moderate risk of bias. However, some studies lacked detailed methodology, leading to uncertainty in assessing the risk of selection and performance bias.

Synthesis of Results

Antioxidant and Immunomodulatory Effects:[10-14]

Amalaki is renowned for its high concentration of vitamin C and polyphenols, which contribute significantly to its antioxidant activity. The vitamin C content, one of the highest among natural sources, plays a key role in scavenging free radicals and protecting cells from oxidative damage. Studies have shown that Amalaki enhances the activity of antioxidant enzymes like superoxide dismutase (SOD), catalase, and glutathione peroxidase, which are crucial for reducing oxidative stress. In addition to its antioxidant effects, Amalaki has demonstrated immunomodulatory properties. Research indicates that it can stimulate both the innate and adaptive immune responses. In animal studies, supplementation with Amalaki improved macrophage function, increased the proliferation of lymphocytes, and enhanced the production of cytokines, such as interleukin-2 (IL-2), interferon-gamma (IFN-ã), and tumor necrosis factor-alpha (TNF-á). These results suggest that Amalaki could play a role in enhancing the immune system's defense against infections and in regulating immune responses during chronic conditions .

Hepatoprotective Activity:[15-18]

Several experimental studies have demonstrated that Amalaki exerts significant hepatoprotective effects, especially in animal models with drug-induced liver injuries. For instance, rats with liver damage caused by substances such as alcohol, carbon tetrachloride (CCl), or acetaminophen showed marked improvement in liver function tests, such as reduced serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP), after administration of Amalaki extracts. The hepatoprotective effects are attributed to Amalaki's ability to enhance the antioxidant defense system in the liver and stabilize cellular membranes, thus protecting hepatocytes from damage. In addition, Amalaki has been reported to prevent lipid peroxidation and the depletion of glutathione, which are key mechanisms of liver injury in oxidative stress conditions .

Anticancer Properties:[19-23]

Amalaki has shown potential anticancer activity across various cancer cell lines, including cervical, lung, breast, and colorectal cancers. In vitro studies suggest that Amalaki extracts inhibit cell proliferation, induce apoptosis, and arrest the cell cycle in cancer cells. One of the primary mechanisms appears to be the regulation of genes involved in apoptosis and cell survival. For example, the extracts downregulate anti-apoptotic genes such as Bcl-2 and upregulate pro-apoptotic genes like Bax, leading to programmed cell death in cancer cells. Furthermore, Amalaki has been shown to inhibit the activation of oncogenes such as c-Myc and nuclear factor-kappa B (NF-êB), which are involved in the progression of several cancers. Animal studies have also demonstrated a reduction in tumor size and growth in rodents with induced tumors, further supporting its potential as an adjunctive anticancer therapy .

Anti-inflammatory and Analgesic Effects:[24-28]

Research on the anti-inflammatory and analgesic properties of Amalaki has been extensive, with several studies highlighting its effectiveness in reducing markers of inflammation and pain. In animal models of induced

inflammation, such as carrageenan-induced paw edema and cotton pellet granuloma formation, Amalaki extracts were shown to significantly reduce inflammation, comparable to nonsteroidal anti-inflammatory drugs (NSAIDs). The reduction in inflammation is thought to be mediated through the inhibition of pro-inflammatory cytokines (such as IL-1â and TNF-á) and enzymes like cyclooxygenase (COX-2), which are central to the inflammatory response. In addition to its anti-inflammatory effects, Amalaki has demonstrated analgesic activity in models of pain, such as acetic acid-induced writhing and tail-flick tests, suggesting its utility in treating inflammatory conditions like arthritis and other musculoskeletal disorders .

Discussion

Summary of Evidence:

This systematic review underscores the diverse pharmacological properties of Amalaki, aligning both with traditional Ayurvedic practices and modern scientific validation. Amalaki's role as a potent antioxidant and immunomodulator is well-established, with studies supporting its use in reducing oxidative stress and enhancing immune responses. These findings are consistent with the Ayurvedic classification of Amalaki as a *rasayana* — an agent promoting longevity, vitality, and overall health.[29-30]

The hepatoprotective effects of Amalaki, demonstrated through various models of liver injury, highlight its relevance in treating liver disorders, which are traditionally addressed in Ayurveda through its *pitta-balancing* properties. Its ability to protect the liver from oxidative damage further supports its use in modern liver disease therapies.[31-33]

Amalaki's anticancer properties, particularly its ability to inhibit tumor growth and promote apoptosis in cancer cells, provide promising evidence for its potential role in cancer therapy. The dual regulation of oncogenes and pro-apoptotic pathways is a significant finding, suggesting that Amalaki could complement conventional cancer treatments.[34-36]

In terms of anti-inflammatory and analgesic effects, Amalaki's ability to reduce inflammation and pain highlights its therapeutic potential in managing chronic inflammatory diseases. These findings resonate with its traditional use in Ayurveda as a remedy for inflammatory conditions, balancing the *tridoshas* (vata, pitta, and kapha) to restore health.

Together, the pharmacological actions of Amalaki provide a broad therapeutic potential that bridges Ayurvedic wisdom with contemporary medical science. However, while preclinical studies are abundant, the lack of large-scale, controlled clinical trials in humans remains a limitation. Future research should focus on elucidating the molecular mechanisms behind Amalaki's effects in human subjects and confirming its efficacy through clinical trials, especially in the context of cancer, liver diseases, and immune modulation.

Limitations

Some limitations of this review include the heterogeneity of the included studies, which made meta-analysis unfeasible. Many studies lacked robust methodology, and few were conducted in human populations, limiting the generalizability of the findings.

Future Directions

More well-designed clinical trials are needed to validate the therapeutic potential of Amalaki in humans. The polypharmacological nature of Amalaki also suggests that a systems pharmacology approach may be valuable in understanding its full therapeutic potential.

Conclusion

Amalaki (Emblica officinalis) is a potent medicinal plant with a wide array of pharmacological properties. While traditional Ayurvedic literature provides a foundation for its use, modern research has begun to validate its benefits. Future studies should focus on clinical trials and elucidating the molecular mechanisms underlying its therapeutic effects.

References :

1. Y.G Joshi; Charak Samhita of Agnivesa; vol2 (Revised edition) Vaidyamitra Publication Sadashive Peth., 2003; 701.
2. Vd.P.G Athavale; Drushtarth Sushrut Samhita; Vol1(first edition) Godavari publishers Nagpur; 2008.
3. Chunekar KC;Bhavprakash Nighhantu; In Varanasi Bharti Academy., 1993; 10-11.
4. Guruprasad Sharma, editor Dhanwantari Nighantu; In Varanasi Chakhambha Orientalia; 2004.
5. Narhari Pandit, Rajnighantu; First edition, Tripathi editor; Varanasi Krishnadas Academy; 2039.
6. Indian Medicinal Plants -A compendium of 500 species Part 3 by Orient Longman Publications., 1997; 256-263.
7. Vasudha Shukla,Manish Vashistha,Som Nath Singh;Evaluation of antioxidant profile and activity of amalaki (Embelica offici-nalis), Spirulina and Wheat grass; Indian Journal Of Clinical Biochemistry., 2009; 24(1): 70-5.

8. Reddy VD, Padmavathi P, Paramahamsa M, Varadacharyulu NC. Amelioration of alcohol-induced oxidative stress by Emblica officinalis (amla) in rats. Indian J Biochem Biophys., 2010; 47: 20-5.
9. Shivananjappa MM, Joshi MK. Influence of Emblica officinalis aqueous extract on growth and antioxidant defense system of human hepatoma cell line (HepG2). Pharm Biol., 2012; 50: 497-505.
10. Bhattacharya A, Chatterjee A, Ghosal S, Bhattacharya SK. Antioxidant activity of active tannoid principles of Emblica officinalis (amla). Indian J Exp Biol., 1999; 37: 676-80.
11. Jeena K Jose, Ramdasan Kuttan; Hepato-protectiva activity of embelica officinalis and chyavanprash., 2000; 72(1-2): 135-140.
12. Tasduq SA, Kaisar P, Gupta DK, Kapahi BK, Maheshwari HS, Jyotsna S, et al. Protective effect of a 50% hydroalcoholic fruit extract of Emblica officinalis against antituberculosis drugs induced liver toxicity. Phytother Res., 2005; 19: 193-7.
13. Sharma A, Sharma MK, Kumar M. Modulatory role of Emblica officinalis fruit extract against arsenic induced oxidative stress in Swiss albino mice. Chem Biol Interact., 2009; 180: 20-30.
14. Damodara Reddy V, Padmavathi P, Gopi S, Paramahamsa M, Varadacharyulu NCh. Protective effect of Emblica officinalis against alcohol-induced hepatic injury by ameliorating oxidative stress in rats. Indian J Clin Biochem., 2010; 25: 419-24.
15. Reddy VD, Padmavathi P, Varadacharyulu NCh. Emblica officinalis protects against alcohol-induced liver mitochondrial dysfunction in rats. J Med Food., 2009; 12: 327-33.
16. Mahata S,Pandey A,Shukla S,Tyagi A,Husain SA,Bharti AC;Anticancer activity of phyllanthus embelica Linn.:inhibition of transcription factor AP-1 and HPV gene expression in cervical cancer cells; Nutr cancer., 2013; 65.
17. Jose JK,Kuttan G, Kuttan R; Antitumour activity of Embelica officinalis; J. Ethanpharmacol., 2001; 75(2-3): 65-9.
18. Zhong ZG, Wu DP, Huang JL, et al. Progallin A isolated from the acetic ether part of the leaves of Phyllanthus emblica L . induces apoptosis of human hepatocellular carcinoma BEL-7404 cells by up-regulation of Bax expression and down-regulation of Bcl-2expression. J Ethnopharmacol., 2011; 133(2): 765-772.
19. Yang CJ, Wang CS, Hung JY, Huang HW, Chia YC, Wang PH, et al. Pyrogallol induces G2-M arrest in human lung cancer cells and inhibits tumor growth in an animal model. Lung Cancer., 2009; 66: 162-8.
20. Krishnaveni M, Mirunalini S. Therapeutic potential of Phyllanthus emblica (amla): The ayurvedic wonder. J Basic Clin Physiol Pharmacol., 2010; 21: 93-105.
21. Patel SS, Goyal RK. Emblica officinalis Geart: A Comprehensive Review on Phytochemistry, Pharmacology and Ethnomedicinal Uses. Res J Med Plant., 2012; 6: 616.
22. Baliga MS, Dsouza JJ. Amla (Emblica officinalis Gaertn), a wonder berry in the treatment and prevention of cancer. Eur J Cancer Prev., 2011; 20: 225-39.
23. Devasagayam TP, Tilak JC, Boloor KK, Sane KS, Ghaskadbi SS, Lele RD. Free radicals and antioxidants in human health: Current status and future prospects. J Assoc Physicians India., 2004; 52: 794-804.
24. Ngamkitidechakul C, Jaijoy K, Hansakul P, Soonthornchareonnon N, Sireeratawong S. Antitumour effects of Phyllanthus emblica L.: Induction of cancer cell apoptosis and inhibition of in vivo tumour promotion and in vitro invasion of human cancer cells. Phytother Res., 2010; 24: 1405-13.
25. Perinayagam JB,Sharma SK,Joseph A,Christina AJ;Evaluation of antipyretic and analgesic activity of Embelica officinalis;J ethanpharmacol., 2004; 95(1): 83-5.
26. Bhomik Goel, Nishant Pathak, , Dwividen-dra Kumar Nim, Sanjay Kumar Singh, Rakesh Kumar Dixit, Rakesh Chaurasia; Evaluation of analgesic activity Embelica officinalis in albino rats; Int J Basic Clin Pharmacol., 2014; 3(2): 365-386.
27. Saees S,Tariq P; Antibacterial activities of Embelica officinalis and Coriandrum sativum against gram negative urinary pathogens; Pakistan Journal of Pharmaceuti-cal Sciences., 2007; 20(1): 32-35.
28. Aneja, Kamal Rai; Joshi, Radhika; and Sharma, Chetan (2010) "In Vitro Anti-microbial Activity of Sapindus mukorossi and Emblica officinalis Against Dental Caries Pathogens," Ethnobotanical Leaflets., 2010; 4.
29. Saini A, Sharma S, Chhibber S. Protective efficacy of Emblica officinalis against Klebsiella pneumoniae induced pneumonia in mice; Indian J Med Res., 2008; 128: 18893.
30. Thaweboon B, Thaweboon S. Effect of Phyllanthus emblica Linn. on candida adhe-sion to oral epithelium and denture acrylic; Asian Pac J Trop Med., 2011; 4: 41-5.

31. Rahman S, Akbor MM, Howlader A, Jabbar A. Antimicrobial and cytotoxic activity of the alkaloids of Amlaki (Emblica offici-nalis). Pak J Biol Sci., 2009; 12: 1152-5.

32. Avneesh Kumar, Bilal Ahmd Tantry, Shaik Rahiman, Upsana Gupta; Comparative study of antimicrobial activity and phytochemical analysis of methanolic and aqueous extracts of the fruit of Embelica officinalis against pathogenic bacteria;J Tradit Chin Med., 2011; 31(3): 246-50.

33. AL-Rehuily AJ, AL-Howiriny ta, al-Sohaibani MO, Rafatullah S; Gasto-protective effect of Embelica officinalis on vivo test models in rats; Indian Journal of clinical Biochemistry., 2002; 24(1): 70-75.

34. Vasudevan M, Parle M. Effect of Anwala churna (Emblica officinalis GAERTN.): an ayurvedic preparation on memory deficit rats. Yakugaku Zasshi., 2007; 127(10): 17011707.

35. Kavitha Nair N, Patel K,Gandhi T; Proession of cataract in sodium selenite induced catarogenic cats; J PharmRes., 2010; 9(2): 147-152.

36. Pranoti Belapurkar, Pragya Goel, Preeti Tiwari; Immunomodulatory effect of triphala and its individual constituents: A review; Indian J Pharm Sci., 2014; 26(6): 467-475. 37. Sai Ram M, Neetu D, Deepti P, et al. Cytoprotective activity of Amla (Emblica officinalis) against chromium (VI) induced oxidative injury in murine macrophages. Phytother Res., 2003; 17(4): 430-433.