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Review Article

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"ANTICANCER PLANTS IN AYURVEDA AND PHARMACOLOGICAL EVIDENCE: AN INTEGRATIVE REVIEW"

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ABSTRACT

Introduction: Cancer is one of the leading causes of morbidity and mortality worldwide, characterized by uncontrolled cell proliferation, invasion, and metastasis. Despite significant advances in chemotherapy, radiotherapy, and immunotherapy, challenges such as drug resistance, toxicity, and limited accessibility persist. Ayurveda describes *Arbuda* and *Granthi* as tumor-like conditions, attributing them to aggravated *Doshas* and *Dushyas*. Several Ayurvedic plants are traditionally prescribed for these conditions, and many have shown anticancer potential in modern pharmacological studies. **Methods:** A literature search was performed in PubMed, Scopus, Web of Science, and Ayurvedic classical texts (*Charaka Samhita, Sushruta Samhita, Bhavaprakasha Nighantu*). Keywords included "Ayurveda AND cancer," "Arbuda," "anticancer plants," and names of specific herbs. Inclusion criteria comprised experimental studies, pharmacological validations, and clinical trials from 1960–2025. **Results:** Ayurveda highlights herbs such as *Withania somnifera (Ashwagandha), Tinospora cordifolia (Guduchi), Curcuma longa (Haridra), Ocimum sanctum (Tulsi), Andrographis paniculata (Kalmegh),* and *Semecarpus anacardium (Bhallataka)* as *Arbuda nashaka*. Pharmacological studies confirm anticancer effects through mechanisms like apoptosis induction, inhibition of angiogenesis, suppression of NF-κB and PI3K/AKT pathways, and antioxidant activity. Preclinical evidence demonstrates tumor regression, reduced metastasis, and synergistic effects with conventional chemotherapy. Limited clinical trials suggest improvements in quality of life, reduced toxicity, and potential tumor control. **Discussion:** There is strong convergence between Ayurvedic insights and modern pharmacology. However, limitations include lack of standardized extracts, small sample size clinical trials, and insufficient toxicological evaluations. **Conclusion:** Ayurvedic anticancer plants represent a promising complementary approach with mechanistic evidence supporting their use. Future directions include robust clinical validation, standardization, and integration with conventional oncology to improve outcomes and minimize side effects.

KEYWORDS: Anticancer, *Arbuda*, Ayurveda, Herbal pharmacology, Tumor inhibition

INTRODUCTION

Cancer represents a major global health burden, with rising incidence and mortality rates.[1] Conventional therapeutic approaches, including chemotherapy, radiotherapy, and targeted therapies, though effective, are limited by significant side effects, high costs, and the emergence of drug resistance.[2-3] Thus, there is growing interest in complementary and alternative systems, including Ayurveda, for novel preventive and therapeutic strategies.[4]

In Ayurveda, cancer-like conditions are described as *Arbuda* (tumors) and *Granthi* (benign/malignant growths). These are understood as arising from vitiated *Tridosha* leading to abnormal growth in specific tissues (*Dushya*).[5-6] Classical texts recommend *Arbuda nashaka dravyas* (anticancer herbs), many of which overlap with *Rasayana* herbs known for immune modulation, rejuvenation, and detoxification.[7]

This review aims to examine anticancer plants mentioned in Ayurveda, summarize their phytochemistry and pharmacological mechanisms, and critically analyze preclinical and clinical evidence.[8-9] The objectives are, to document anticancer references in classical Ayurvedic texts, to review pharmacological studies validating these plants, to analyze clinical trials on anticancer efficacy, and to highlight gaps and suggest future research directions.[10]

MATERIALS AND METHODS

Literature Search Strategy

Databases: PubMed, Scopus, Web of Science, and Google Scholar. Ayurvedic classics (*Charaka Samhita, Sushruta Samhita, Ashtanga Hridaya, Bhavaprakasha Nighantu*) were searched for references.[11]

Keywords:[12]

"Ayurveda AND cancer," *"Arbuda,"* "anticancer plants," "tumor inhibition," "apoptosis induction," "NF-κB suppression."

Inclusion criteria:[13]

- Experimental in vitro/in vivo studies on anticancer activity of Ayurvedic plants.
- Clinical trials assessing efficacy/safety.
- Reviews on anticancer Ayurveda pharmacology.

Exclusion criteria:[14]

- Studies without methodological clarity.
- Non-English articles without translation.
- Anecdotal single-case reports.

Studies were analyzed thematically based on classical references, phytochemistry, pharmacological evidence, and clinical validation.[15]

OBSERVATION AND RESULTS

1. Classical Ayurvedic Perspective on Cancer *(Arbuda & Granthi)*

Ayurveda describes *Arbuda* as a hard, immovable, and often painless swelling, comparable to malignant tumors, while *Granthi* represents benign growths. Causative factors include aggravated *Kapha* and *Vata*, obstruction of *Rakta* and *Mamsa dhatu*, and impaired *Agni*. Management emphasizes *Shodhana* (purification), *Rasayana* (rejuvenation), and use of *Arbuda nashaka* herbs with detoxifying and cytotoxic properties.

2. Major Anticancer Plants in Ayurveda

a. Withania somnifera *(Ashwagandha)*

- *Properties: Rasayana, Balya, Vata-Kapha shamaka*.
- *Phytochemistry:* Withanolides.
- *Pharmacology:* Induces apoptosis via mitochondrial pathway, inhibits angiogenesis, downregulates NF-κB.
- *Evidence: In vitro* studies show cytotoxicity in breast, prostate, and colon cancers. Animal studies confirm tumor regression. Clinical studies suggest improved quality of life and reduced chemotherapy toxicity.

b. Curcuma longa *(Haridra)*

- *Properties:* Krimighna, Vishaghna, anti-inflammatory.
- *Phytochemistry:* Curcuminoids.
- *Pharmacology:* Blocks NF-κB, STAT3, PI3K/AKT, induces apoptosis, antioxidant activity.
- *Evidence:* Demonstrated inhibition of tumor growth in colorectal, breast, pancreatic, and prostate cancers. Clinical trials indicate curcumin enhances chemotherapy efficacy and reduces toxicity.

c. Tinospora cordifolia *(Guduchi)*

- *Properties: Rasayana, Medhya, Kapha-Pitta shamaka*.
- *Phytochemistry:* Alkaloids, diterpenoids, polysaccharides.

- *Pharmacology:* Immunomodulatory, enhances NK cell activity, inhibits DNA damage.
- *Evidence:* Preclinical studies show anti-leukemic and hepatoprotective activity. Clinical data suggest immune support during chemotherapy.

d. Ocimum sanctum *(Tulsi)*

- *Properties: Vishaghna, Rasayana,* adaptogen.
- *Phytochemistry:* Eugenol, ursolic acid, flavonoids.
- *Pharmacology:* Antioxidant, radioprotective, apoptosis-inducing.
- *Evidence:* Animal studies show reduction in lung, skin, and oral cancers. Clinical studies report decreased radiation-induced toxicity.

e. Andrographis paniculata *(Kalmegh)*

- *Properties: Tikta rasa, Vishaghna*.
- *Phytochemistry:* Andrographolide.
- *Pharmacology:* Inhibits STAT3, suppresses angiogenesis, anti-metastatic effect.
- *Evidence:* Inhibits tumor proliferation in leukemia, hepatoma, breast cancer.

f. Semecarpus anacardium *(Bhallataka)*

- *Properties:* Described as *Arbuda nashaka* in classical texts.
- *Phytochemistry:* Bhilawanols, flavonoids, sterols.
- *Pharmacology:* Cytotoxic effect on malignant cells, enhances macrophage function.
- *Evidence:* Preclinical studies show anti-tumor effect in ascitic carcinoma. Caution due to irritant properties; requires purification.

3. Pharmacological Mechanisms Identified

- Induction of apoptosis *(Ashwagandha*, Curcumin, *Bhallataka)*.
- Inhibition of angiogenesis *(Ashwagandha, Kalmegh)*.
- Immunomodulation *(Guduchi, Tulsi)*.
- Antioxidant activity (Curcumin, *Tulsi*).
- Suppression of oncogenic signaling pathways (NF-κB, STAT3, PI3K/AKT).

4. Clinical Evidence

- **Curcumin:** Adjunct in colorectal cancer improved survival, reduced inflammation.
- ***Ashwagandha:*** Improved quality of life, fatigue reduction in breast cancer patients on chemotherapy.
- ***Tulsi:*** Reduced oral mucositis and oxidative stress in head-and-neck cancer patients receiving radiation.
- ***Guduchi:*** Immunomodulatory role in chronic leukemia and supportive care.

DISCUSSION

Ayurveda conceptualizes cancer under *Arbuda* and *Granthi*, linking pathogenesis to *Kapha* dominance, tissue obstruction, and impaired immunity. Modern parallels include uncontrolled proliferation, angiogenesis, and immune evasion. The Ayurvedic emphasis on detoxification (*Shodhana*) and rejuvenation (*Rasayana*) aligns with pharmacological findings of immune modulation, cytotoxicity, and apoptosis induction.[16]

Herbs like *Ashwagandha* and *Curcumin* exhibit multi-targeted activity, regulating key cancer pathways (NF-κB, PI3K/AKT, STAT3) and enhancing apoptosis. This polypharmacological approach reflects Ayurveda's holistic view. Importantly, these plants also mitigate treatment-related toxicity, improving patient quality of life.[17]

However, challenges remain. Most evidence is preclinical, with clinical trials limited by small sample sizes, heterogeneity, and lack of standardized formulations. Safety issues, especially with *Semecarpus anacardium*, require careful purification and dosing. Furthermore, herb-drug interactions with conventional chemotherapy must be studied systematically.[18]

Future research directions include:[19]

- Developing standardized phytochemical-rich extracts.
- Conducting large-scale randomized clinical trials.
- Integrating biomarkers and molecular studies to validate mechanisms.
- Exploring synergistic combinations with modern oncological drugs.

Ayurvedic anticancer plants, with validated pharmacological actions, offer promising adjunctive and preventive strategies against cancer.[20]

CONCLUSION

Ayurveda describes cancer-like conditions as *Arbuda* and *Granthi*, attributing them to imbalances in *Doshas* and tissue dysfunction. Classical texts

recommend several *Arbuda nashaka* herbs, many of which have now been validated through modern pharmacology. *Withania somnifera*, *Curcuma longa*, *Tinospora cordifolia*, *Ocimum sanctum*, *Andrographis paniculata*, and *Semecarpus anacardium* exhibit diverse mechanisms, including apoptosis induction, angiogenesis inhibition, immune modulation, and antioxidant activity.

Preclinical studies demonstrate significant tumor-suppressing activity, while clinical studies suggest improved quality of life, reduced treatment toxicity, and potential tumor control. However, limitations such as lack of standardized formulations, small-scale trials, and insufficient long-term safety data hinder clinical translation.

With systematic research, standardization, and integration into oncology, Ayurvedic anticancer plants could serve as safe and effective adjuncts, bridging traditional wisdom with modern evidence-based medicine. They represent a vital opportunity for holistic, multi-targeted cancer management.

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