

## EXPLORING SELECTED MEDICINAL PLANTS FOR THEIR ANTINEOPLASTIC ACTIVITY: A REVIEW FROM AN AYURVEDIC PERSPECTIVE

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### ABSTRACT

Cancer is the global health issues and various measure are taken by WHO, CCRAS and other health organisation for control of disease and elimination of side effects. While modern medicine primarily provides interventional treatment and symptomatic management. Ayurveda emphasizes on personalised and holistic approach which aims to restore balance, well-being and reduce side effects of interventional treatment. Dravyaguna has a large collection of medicinal plants with information about uses, properties and chemical composition and anticancer effect. It acts on basis of *Rasa*, *Virya*, *Vipaka*, *Guna* and *Karma*. Recent studies have explored the diverse therapeutic action of medicinal plants like anti-inflammatory, antioxidant, antitumor etc. through various experimental and clinical approach. Additionally, future efforts must focus on creation of digital database and to conduct large-scale clinical trials to reinforce *Dravyaguna* as evidence-based medicine. This paper presents current studies ranging from in vivo and in vitro to limited clinical trials on herbs *Ashwagandha*, *Gudduchi*, *Shallaki*, *Guggulu*, *Pippali*, *Devdaru*. It also outlines the future scope of study with the need to harmonize *Ayurvedic* and Modern medicine.

**KEYWORDS:** *Dravyaguna*, Cancer, *Ayurveda*.

### INTRODUCTION

Recent studies suggests that Cancer is one of the leading causes of mortality and morbidity globally. It is a leading public health issue due to the increasing number of new cases yearly. According to the Seventieth World Health Assembly which was conducted in May 2017 predicted the rise in new cancer cases from 14.1 million in 2012 to 21.6 million by 2030.<sup>[1]</sup>

Cancer is stated as incontinent cell proliferation, its disrupts and damages tissues and organ functioning. With respects to increasing percentage of cancer cases worldwide recent studies in modern medicine and *Ayurveda* plays a crucial role but there is a need for future researches for control of cases and improving standard of living among survived individuals.

*Ayurveda* is ancient branch of medicine offers promising measures and treatment on various chronic diseases. It not only focuses on curative treatment but also plays

pivotal role in well being and prevention of diseases, especially when conventional therapies fall short or cause complications.

*Dravyaguna* a branch of ayurveda that forms interlacing between traditional knowledge and modern science. It offers herbs which can be personalised and used according to *Prakruti*, *Agni*, *Doshas* etc. of each individual. Cancer and its various types, each with individual peculiarity needs distinct treatment. Herbs, herbal formulation and Herbo-mineral preparations provides personalised management which exhibits action against chronic diseases. With ongoing researches and integrative approaches, *Dravyaguna* is set to play a major role in holistic oncology.

### MATERIAL AND METHODS

The understanding of *Ayurveda* from ancient literature- *Charak Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, *Ashtanga Sangraha*. The study of *Dravyaguna* and its

principles from various *Nighantus*, Ayurvedic Pharmacopoeia of India and modern literature and books. Recent research from available and published Articles, Journals, Research papers, Internet. WHO, ICMR, NIH, Centre of Disease Control and Prevention for recent database of diseases, PubMed, ResearchGate.

## OBSERVATION

### Modern perspective on cancer<sup>[3]</sup>

“Cancer is a disease characterised by uncontrolled cell proliferation, invasion into surrounding tissues and often metastasis to distant organs”<sup>[2]</sup> is defined by World Health organization, 2024. Development of tumour takes place through 3 stages namely.

1. Genetic mutation
2. Hyperplasia
3. Dysplasia

After the initial stages cancer develops as carcinoma in situ, which if left untreated, may further progress to malignant form. The targeted organ or tissues are affected and eventually metastasis, it not only results in failure of distant organs and system but also compromises immune system and digestion.

Cancer treatment in modern healthcare relies on multidisciplinary methods like chemotherapy, radiation therapy, hormone therapy, immunotherapy, angiogenesis inhibitors, biological therapy, targeted drug therapy and surgical interventions. The treatment strategies are based on.

1. Neoadjuvant therapy
2. Combined modality therapy
3. Adjuvant therapy

Management of cancer is necessary in A) Pre- treatment phase B) Active medical intervention phase and C) Recovery and monitoring phase.

### Causative factors for Cancer<sup>[4]</sup>

Several interconnected factors contribute to development of cancer such as genetic mutations, environmental factors, lifestyle factors (drinking, smoking), Infection (HPV, HCV/HBV, H. Pylori), hormonal imbalances, chronic inflammation. Early diagnosis is the key for curing cancer where Imaging (CT, MRI, PET Scan, USG), Biopsy, Tumour markers (PSA, CA-125, AFP, CEA). Molecular tests provide early assessment and diagnosis.

### Ayurveda based understanding of cancer

Ayurvedic literature identifies the closest resemblance of cancer with *Arbuda* and *Granthi* which shares similarities with the characteristics of tumours and cancerous growth. The term *Arbuda* is described in *Sushrut Samhita* as firm, painless, immovable, and progressively enlarging mass with no pus discharge while *Granthi* is described as localised nodular swelling, often smaller in size.<sup>[5]</sup> Both of these conditions arise due to vitiation of *Tridoshas* leading to abnormal tissue

growth. This correlation paves the way for developing Ayurvedic approaches for cancer management. Ayurveda approaches to cancer management through *Tridosha* balancing, detoxification, diet and lifestyle management and *Rasayana* therapies.<sup>[6]</sup>

### Mechanism of Anticancerous activity from *Dravyaguna Vigyan*

*Dravyaguna* offers larger sources of herbs which balances *Tridoshas*, enhances digestion, promotes internal healing, boosts immunity and speed up recovery. It contributes to supportive and palliative use, mental health (acts on anxiety and depression), detoxification (*Shodhana*), and Herbo-mineral formulations which are based on *Dravyaguna* principles.

Certain herbs have antioxidant, anti-inflammatory, immunomodulatory, cytotoxic properties which acts as anticancerous. This therapeutic action of herbs is attributed to their *Rasa* (taste), *Virya* (potency), *Vipaka* (post-digestive effect), *Prabhava* (unique action), *Guna* (qualities), *Karma* (pharmacological action), *Doshaghnata* (ability to pacify aggravated *doshas*) of herbs. The action of herbs is also influenced by the *Agni* (digestive fire), *Prakruti* (the individual constitution), *Dhatu*s and *Rugna* (specific condition of the patient) which highlights the personalised approach in ayurvedic treatments.<sup>[6]</sup> The personalised approach is a distinctive feature of herbal usage, emphasizing treatment tailored to the individual's constitution and health condition which acts against various types of cancer each possessing unique pathological characteristics and progression patterns.

The action of *Ayurvedic* medicine acts on all three phases A) Pre- treatment phase – Assessment of *Rogi* and *Roga bala*, *Ama Nirharan* (removing toxins through *Deepan Pachana*), preparing for body detox if *Panchakarma* is planned.

B) Active medical intervention phase- *Rasayana* therapy to boost immunity and tissue repair e.g. *Guduchi*, *Ashwagandha*, *Amalaki*. *Shamana chikitsa* to reduce side effects like nausea, vomiting, fatigue e.g. *Shunthi*, *Yashtimadhu*.<sup>[7]</sup> Mental health support where use of *Medhya Rasayana* like *Bramhi*, *Mandukparani* for anxiety and depression is beneficial. Lastly personalised diet (*Pathya-Apathya*), *Yoga*, *Pranayama* for diet and lifestyle management.

C) Recovery and monitoring phase- Post *Shodhana Rasayana* therapy which enhances recovery and restore vitality.<sup>[8]</sup> *Ojas vardhana chikitsa* for strengthening life essence using herbs like *Shatavari*, ghee based *Rasayana*. Long term lifestyle regulation by means of *Dincharya*, *Ritucharya* and stress management. Lastly *Nidana Parivarjana* (preventive measure) which suggests avoiding known triggers and unhealthy behaviour improves quality of life.

It helps to manage during and post cancer complications such as cachexia, anorexia, diarrhoea, constipation, nausea, anxiety, cough and fatigue through its restorative and supportive action.

Some Evidence based anticancer herbs and recent studies on oncology.<sup>[9]</sup>

### 1. Ashwagandha (*Withania somnifera*)

Rasa – Madhura, Tikta, Kashaya

Vipaka – Madhura

Virya – Ushna

Guna – Laghu, Snighada

Doshaghnata – Vataghna, Kaphaghna

Chemical composition – Withaferin A, withanolide D, withanone, sitoindosides, ashwagandholine, alkaloids.

Pharmacological activity – Cytoprotective, immunostimulatory, immunomodulatory, antitumour, antistress, anticonvulsant, antioxidant, antipyretic, antiviral, cardioprotective, antiaging.

Recent studies – Withaferin A induces cell death in breast cancer and prostate cancer cells.<sup>[10]</sup> An alcoholic leaf extract of *Ashwagandha* (i-extract) was shown to selectively eliminate cancer cells leading to identification of specific tumour-inhibitory compound and offering initial molecular insights into its mode of action.<sup>[11]</sup>

### 2. Guduchi (*Tinospora cordifolia*)

Rasa – Tikta, Katu, Kashaya

Vipaka – Madhura

Virya – Ushna

Guna – Fresh (*Snighada, Mrudu*) Dried (*Ruksha, Laghu, Mrudu*),

Doshaghnata – Vataghna, Pittaghna, Kaphaghna, Tridoshaghna

Chemical composition – Tinosporaside, cordifolioside A, berberine, palmatine, giloinin, saponins, steroids.

Pharmacological activity – Antioxidant, antineoplastic, antistress, hepatoprotective, analgesic, immunostimulant, antitumour, adaptogenic, antibacterial, antiallergic, hypoglycemic.

Recent studies – An in vitro study demonstrated the anti-brain cancer potential of chloroform and hexane extracts derived from *Guduchi* highlighting their cytotoxic effects against brain cancer cells.<sup>[12]</sup> Also, recent studies of *Ayurvedic* herbs in mice bearing Dalton's lymphoma ascities, along with their short- term cytotoxicity against DLA cell lines in vitro and in Ehrlich ascities carcinoma bearing mice.<sup>[13]</sup>

### 3. Pippali (*Piper longum*)

Fresh: Rasa – Madhura, Vipaka- Madhura, Virya – Shitta, Guna – Guru, Doshaghnata – Kaphavatavardhak Pittashamaka

Dried: Rasa – Katu, Vipaka – Madhura, Virya – Anushna, Guna – Laghu Snighada Tikshana, Doshaghnata – Kaphaghna Pittakar Vatashamaka.

Chemical composition – Piperine, piperlongumine, sesamin, piperlyline, piperlylonguminine,

Pharmacological activity – Antitubercular, anti-inflammatory, cough suppressor, antispasmodic, antinarcotic, antiulcerogenic, antibacterial.

Recent studies – In vivo studies on *Piper longum* extract showed tumour growth inhibition without toxicity supporting potential safety and efficacy. In vitro study of ethanolic extract of *Piper longum* showed selective cytotoxicity against PANC-1 pancreatic cancer cells under nutrition deprived condition.<sup>[14]</sup>

### 4. Devadaru (*Cedrus deodara*)

Rasa – Tikta

Vipaka – Katu

Virya – Ushna

Guna – Laghu, Snighada

Doshaghnata – Vatapittaghna.

Chemical composition – Cedrol, himachalane ( $\alpha$ -,  $\beta$ -,  $\gamma$ -), deodarin, flavonoids and polyphenols, cedrus oil.

Pharmacological activity – Immunomodulatory, analgesic, anti-inflammatory, spasmolytic, antibacterial, antiviral, antiseptic, antidiabetic, antipassive cutaneous activity.

Recent studies – *Devadaru*'s total lignans (CTL) showed anticancer potential by inhibiting the growth of A549 lung cancer cells at low doses, increasing apoptosis and causing cell cycle arrest in the G2/M phase in rats using 1,2- dimethylhydrazine induced cancer model, suggesting possible therapeutic use in lung adenocarcinoma.<sup>[15]</sup> The alcoholic extract of stem of *Devdaru* demonstrated anticancer effect against human nasopharyngeal epidermoid carcinoma cells in tissue culture.<sup>[16]</sup>

### 5. Shallaki (*Boswellia serrata*)

Rasa – Katu tikta Madhura

Vipaka – Katu

Virya – Ushna

Guna – Laghu Ruksha

Doshaghnata – Kaphapittaghna.

Chemical composition – Boswellic acids (11-keto- $\beta$ -boswellic acid and acetyl-11-keto- $\beta$ -boswellic acid or AKBA), incensole, incensole acetate, lupeolic acid, essential oils ( $\alpha$ -thujene,  $\alpha$ -pinene, limonene).

Pharmacological activity – Anti-inflammatory, antiulcerogenic, anticancer, antitumour, immunomodulatory, joint- vascular supportive.

Recent studies – In randomized trials and case series, patients with radiation- induced necrosis or cerebral oedema following stereotactic radiosurgery were treated with high doses of *Boswellia* (4200-4500 mg/day), resulting in  $\geq 75\%$  reduction in cases of peritumoral oedema in approximately 60% of cases, compared to 25% in placebo group, allowing for steroidal reduction or discontinuation.<sup>[17]</sup> Other clinical researches regarding analgesic action, reducing tumour cell proliferation, anti-inflammatory effect are conducted on *Shallaki*.

### 6. Guggulu (*Commiphora mukul*)

Rasa – Tikta Katu Kashaya

Vipaka – Katu

Virya – Ushna

Guna – Laghu Ruksha Tikshna Vishada Sukshma Sara Sugandhi (Old Guggula) Pichila Snighada (New Guggula)

Doshaghnata – Vatashamana Kaphashamana

Chemical composition – Guggulsterones (Z and E), myrrhanol A, Myrrhanone A, commipheric acids, commipherol, sesquiterpenes.

Pharmacological activity – Anti-inflammatory, antiviral, antibacterial, antisclerotic, Ca<sup>+</sup> antagonist activity, hypolipidemic.

Recent studies – The hydro- alcoholic extract of *Kanchanar Guggulu* demonstrated significant cytotoxic activity by inhibiting cell division in *Allium cepa* assay and reducing cell proliferation in yeast model, suggesting its potential anticancer effects due to presence of flavonoids and phenolic compounds.<sup>[18]</sup> *Commiphora mukul* and its active compounds were evaluated for its effect on oral cancer, the findings suggested that it acts as chemoprotective and therapeutic agents for oral cancer.<sup>[19]</sup>

Sr. No	Name	Rasa	Vipaka	Virya	Guna	Doshaghnata
1.	<i>Ashwagandha (Withania somnifera)</i>	Madhura Tikta Kashaya	Madhura	Ushna	Laghu, Snighada	Vataghna, Kaphaghna
2.	<i>Guduchi (Tinospora cordifolia)</i>	Tikta Katu Kashaya	Madhura	Ushna	Fresh (Snighada, Mrudu) Dried (Ruksha, Laghu, Mrudu)	Vataghna, Pittaghna, Kaphaghna, Tridoshaghna
3.	<i>Pippali (Piper longum)</i>	Fresh: Madhura	Madhura	Shitta	Guru	Kaphavatavardhak, Pittashamaka
		Dried: Katu	Madhura	Anushna	Laghu Snighada Tikshana	Kaphaghna, Pittakar, vatashamaka
4.	<i>Devadaru (Cedrus deodara)</i>	Tikta	Katu	Ushna	Laghu Snighada	Vatapittaghna.
5.	<i>Shallaki (Boswellia serrata)</i>	Katu Tikta Madhura	Katu	Ushna	Laghu Ruksha	Kaphapittaghna.
6.	<i>Guggulu (Commiphora mukul)</i>	Tikta Katu Kashaya	Katu	Ushna	Laghu Ruksha Tikshna Vishada Sukshma Sara Sugandhi (old) Pichila Snighada (New)	Vatashamana, Kaphashamana

Sr. No	Name	Chemical composition	Pharmacological action
1.	<i>Ashwagandha (Withania somnifera)</i>	Withaferin A, withanolide D, withanone, sitoindosides, ashwagandholine, alkaloids.	Cytoprotective, immunostimulatory, immunomodulatory, antitumour, antistress, anticonvulsant, antioxidant, antipyretic, antiviral, cardioprotective, antiaging.
2.	<i>Guduchi (Tinospora cordifolia)</i>	Tinosporaside, cordifolioside A, berberine, palmatine, giloinin, saponins, steroids.	Antioxidant, antineoplastic, antistress, hepatoprotective, analgesic, immunostimulant, antitumour, adaptogenic, antibacterial, antiallergic, hypoglycemic.
3.	<i>Pippali (Piper longum)</i>	Piperine, piperlongumine, sesamin, piperlyline, piperlylonguminine.	Antitubercular, anti-inflammatory, cough suppressor, antispasmodic, antinarcotic, antiulcerogenic, antibacterial.
4.	<i>Devadaru (Cedrus deodara)</i>	Cedrol, himachalane ( $\alpha$ -, $\beta$ -, $\gamma$ -), deodarin, flavonoids and polyphenols, cedrus oil.	Immunomodulatory, analgesic, anti-inflammatory, spasmolytic, antibacterial, antiviral, antiseptic, antidiabetic, antipassive cutaneous activity.
5.	<i>Shallaki (Boswellia serrata)</i>	Boswellic acids (11-keto- $\beta$ -boswellic acid and acetyl-11-keto- $\beta$ -boswellic acid or AKBA), incensole, incensole acetate, lupeolic acid, essential oils ( $\alpha$ -thujene, $\alpha$ -pinene, limonene).	Anti-inflammatory, antiulcerogenic, anticancer, antitumour, immunomodulatory, joint-vascular supportive.
6.	<i>Guggulu (Commiphora mukul)</i>	Guggulsterones (Z and E), myrrhanol A, Myrrhanone A, commipheric acids, commipherol, sesquiterpenes.	Anti-inflammatory, antiviral, antibacterial, antisclerotic, Ca <sup>+</sup> antagonist activity, hypolipidemic.

### Novel research tools and techniques in Dravyaguna

Ayurvedic tools and techniques- *Rasapanchaka*, *Yukti* and *Anumana*, *Dravya pariksha vidhi*, Experimental Pharmacology, Macroscopic and Microscopic description from classical texts.

Modern scientific research techniques- Pharmacognosy, Phytochemical analysis, Macroscopic and Microscopic studies, Analytical chemistry (TLC, HPTLC, HPLC, GLC), Chemometrics, Experimental pharmacology, Bioinformatics and Omics technologies, Nano formulations, Molecular docking, Metabolomics and Genomics. DNA Barcoding is an emerging tool for Authenticating *Ayurvedic* Medicinal Plants.

### DISCUSSION

Although modern medicine provides various treatment options, they are often associated with adverse effects. Modern medicine falls short in managing after effects of its own treatment where *Ayurveda* come into action with its holistic solutions and supportive care. *Dravyaguna* describes specific properties of herbs which are immunity enhancing effect (*vyadhikshamatva*), delays tissue degeneration and improves tissue repair that contributes to wide range of therapeutic actions against various diseases.

Recent and ongoing research on medicinal herbs supports an evidence-based approach and strengthen the scientific foundation of *Ayurveda*. The study suggested medicinal plants with its chemical composition acts as apoptosis, antiproliferative, angiogenic inhibitor, antimetastatic, antioxidant, cytotoxic, catalyst, antitumour, arrests cell cycle and also improves quality of life among cancer survivors. These effects are largely attributed to presence of flavonoids, polyphenols and other unique chemical constituents found in medicinal plants.

### Future approach

While in vitro and in vivo studies, along with a few clinical trials, have demonstrated encouraging results, the lack of large-scale human trials limits the outcomes of these findings. Reverse pharmacology that is further clinical trials with broader sample sizes are essential to validate the therapeutic potential of future studies on cancer.

However, there is need of standardization and quality control for identification of active markers and enhancing batch to batch consistency of herbs ultimately supporting to evidence-based clinical practice. Nanotechnology a new perspective which promotes delivery, absorption and stability of herbal compound holds significant scope for developing targeted therapies with improved efficacy and reduced side effects in the future.<sup>[20]</sup>

A blend of modern treatment strategies with traditional knowledge of *Ayurveda* to reinforce cancer management

through Integrative Oncology Centres, holds potential to offer more comprehensive and personalised care.

### CONCLUSION

Classical approach of *Dravyaguna* suggests that Pre-treatment phase, Intervention phase and Recovery phase of cancer are managed by means of internal healing, enhancing immune system, restoration of health and relieving sign symptoms of chemotherapy, radiotherapy and reduce their side effects. Herbal interventions not only contribute to improved clinical outcomes but also enhance quality of life and increases life span of patients.

Taking into account the existing clinical scenario, cancer is a multiphase journey. Modern interventions focus on elimination of cancer while *Ayurveda* plays complementary role in immune support, mental health, detoxification and long-term validity. Past studies suggests that several medicinal plants – *Ashwagandha*, *Gudduchi*, *Shallaki*, *Guggulu*, *Pippali*, *Devdaru* have shown significant anticancer activity in preclinical and early phases of studies. *Dravyaguna* can offer both preventive and supportive roles in oncology. The easy availability and cost effectivity of *Ayurvedic* herbs makes them available to wide range of population especially where sources are limited. Future avenues will promisingly strengthen the blend of *Ayurvedic* and Modern treatment strategies leading to better quality of life. Current evidence of researches is preliminary and further large scale Randomised Controlled Trials are needed to validate long term efficacy, vitality advantage and optimal dosing regimen.

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