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"AYURVEDIC LIFESTYLE AND HERBAL STRATEGIES FOR CANCER PREVENTION: AN INTEGRATIVE REVIEW"

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Abstract: Cancer is a major global health challenge and is strongly associated with lifestyle and environmental risk factors, including unhealthy diet, tobacco use, alcohol consumption and physical inactivity. Preventive strategies focusing on lifestyle regulation and early risk reduction are therefore critical for reducing cancer burden. Ayurveda, the traditional system of medicine of India, offers a comprehensive framework for disease prevention through lifestyle practices, dietary regulation, and the use of medicinal plants.

This review examines the role of Ayurvedic lifestyle practices and *Rasayana*-based herbal interventions in cancer prevention by integrating traditional concepts with contemporary biomedical evidence. Practices such as *Dinacharya* (daily regimen) and *Ritucharya* (seasonal regimen) promote circadian balance and physiological homeostasis, while yoga and meditation contribute to stress regulation and immune resilience. Ayurvedic dietary principles, along with medicinal plants such as *Haridra* (*Curcuma longa)*, *Ashwagandha* (*Withania somnifera)*, *Guduchi* (*Tinospora cordifolia)*, provide bioactive compounds with antioxidant, anti-inflammatory, and immunomodulatory properties.

These interventions may help regulate key biological processes associated with carcinogenesis, including oxidative stress, chronic inflammation, and immune dysfunction. Overall, Ayurveda presents a holistic, lifestyle-based approach that may complement modern preventive strategies. However, further clinical studies are needed to validate its role in evidence-based cancer prevention.

***Keywords*:** Ayurveda; *Rasayana*; cancer prevention; medicinal plants; phytochemicals; lifestyle medicine; integrative oncology.

1. INTRODUCTION

Cancer continues to be one of the most significant public health challenges worldwide. According to recent global estimates, millions of new cancer cases are diagnosed annually, and cancer-related mortality remains high across many regions[1]. Population aging, environmental changes, and lifestyle transitions have contributed to the increasing incidence of several malignancies. Despite advances in early detection and treatment, the overall global burden of cancer remains substantial. Therefore, preventive strategies aimed at reducing cancer incidence have become a central component of modern public health programs[1].

A substantial proportion of cancers are associated with modifiable lifestyle behaviors. Tobacco use remains the most important preventable cause of cancer globally and is strongly linked to lung, oral, and several other malignancies[2]. Alcohol consumption has also been associated with increased risk of cancers affecting the liver, breast, and gastrointestinal tract[3]. Dietary patterns represent another important determinant of cancer risk. Diets

rich in processed foods and unhealthy fats are frequently associated with obesity and metabolic disturbances that may contribute to carcinogenesis. Conversely, diets rich in fruits, vegetables, and plant-derived phytochemicals have been linked with reduced cancer risk[3]. Environmental exposures such as industrial pollutants, radiation, and toxic chemicals may also induce genetic damage and oxidative stress, thereby contributing to cancer development[1].

Traditional systems of medicine have historically emphasized disease prevention as an essential component of healthcare. Ayurveda, the traditional medical system of India, describes health as a state of equilibrium between the body, mind, and environment[4]. According to Ayurveda, disease arises when there is an imbalance in the three functional principles known as *Doshas* - *Vata*, *Pitta*, and *Kapha*[7].

Ayurveda promotes preventive healthcare through lifestyle regulation, dietary discipline, and herbal medicines. Practices such as *Dinacharya* (daily routine) and *Ritucharya* (seasonal adaptation) are designed to maintain physiological balance and promote overall well-being[5–6]. Among the preventive approaches described in Ayurveda, *Rasayana* therapy also occupies a particularly important role. *Rasayana* interventions are traditionally described as rejuvenative therapies that promote longevity, improve immunity, enhance tissue nourishment, and strengthen resistance to disease[29]. Many herbs classified under *Rasayana* possess antioxidant, anti-inflammatory, and immunomodulatory properties. These pharmacological activities may be relevant to cancer prevention. In addition to lifestyle practices, Ayurveda places considerable importance on mind–body interventions, including yoga and meditation, which are believed to support mental well-being and physiological resilience. Contemporary research suggests that these practices may contribute to improved immune function, reduced stress responses, and lower levels of systemic inflammation, which are relevant to cancer prevention[26].

Aim of the Review:

The present review aims to examine the role of Ayurvedic lifestyle practices like *Dinacharya*, *Ritucharya*, Yoga, meditation and herbal interventions along with *Rasayanas* in cancer prevention by integrating traditional Ayurvedic concepts with contemporary biomedical evidence.

2. MATERIALS AND METHODS

This study was conducted as a narrative review to evaluate the relationship between Ayurvedic preventive concepts and cancer prevention.

2.1 Literature Search Strategy

Relevant literature was retrieved from electronic databases including PubMed, Scopus, and Google Scholar. Search terms included "Ayurveda," "Rasayana," "cancer prevention," "medicinal plants," "phytochemicals," "lifestyle," "yoga," and "immunomodulation."

2.2 Inclusion Criteria: Studies were included if they:

1. Described lifestyle factors associated with cancer risk
2. Discussed Ayurvedic preventive concepts
3. Reported anticancer activities of medicinal plants
4. Investigated biological mechanisms related to carcinogenesis

Both classical Ayurvedic literature and modern scientific publications were reviewed.

2.3 Data Synthesis

Information extracted from the literature was organized into thematic categories including lifestyle factors, Ayurvedic preventive practices, *Rasayana* herbs, other dietary herbs and molecular mechanisms relevant to cancer prevention.

3. RESULTS

3.1 Lifestyle Factors Associated with Cancer Risk

A substantial proportion of cancer cases worldwide are linked to lifestyle and environmental factors that promote carcinogenesis through chronic inflammation, metabolic dysregulation, oxidative stress, and DNA damage[1-3]. The major risk factors and their associated cancer types are summarized in Table No. 1.

Table 1. Lifestyle factors associated with cancer risk

Lifestyle factor	Potential health impact	References
Tobacco use	Lung, oral and multiple cancers	1,2
Alcohol consumption	Liver, esophageal and breast cancers	2

Unhealthy diet and obesity	Colorectal, breast, pancreatic cancers	3
Physical inactivity	Increased risk of colorectal and breast cancers	3
Environmental toxins	DNA damage and carcinogenesis	2

3.2 Ayurvedic Lifestyle Practices

Ayurveda promotes preventive healthcare through structured *Dinacharya* (daily routine) and *Ritucharya* (seasonal routines). Several of these practices align with modern biomedical evidence for example, the *Dinacharya* concept of maintaining a regular daily routine parallels chronobiology research linking circadian rhythm disruption to cancer risk through hormonal and immune dysregulation[27]. Mind-body practices such as yoga and meditation have similarly been associated with reduced cortisol levels and improved immune function[26]. Key Ayurvedic lifestyle concepts and their modern scientific interpretations are compared in Table No. 2.

Table 2. Ayurvedic lifestyle practices and their modern interpretation

Ayurvedic concept	Practice	Possible modern interpretation	References
Dinacharya	Daily routine	Circadian rhythm regulation	5,27
Ritucharya	Seasonal regimen	Environmental adaptation	5
Yoga	Mind–body practice	Stress reduction and improved immunity	26
Meditation	Mental discipline	Reduced cortisol and inflammation	26
Sattvic nutrition	Balanced diet	Increased antioxidant intake	3,7
Rasayana	Rejuvination	immunomodulation, anti-aging, disease resistance	29

3.3 Ayurvedic Medicinal Plants with Anticancer Potential

Numerous medicinal plants used in Ayurvedic practice including *Rasayana* herbs traditionally employed for longevity and immune strengthening, as well as dietary botanicals contain phytochemicals with demonstrated anticancer potential in experimental studies[9,19-21]. These herbs, their bioactive constituents, and reported biological actions are presented in Table No.3.

Table 3. Ayurvedic medicinal plants with reported anticancer properties

Herb	Botanical name	Major bioactive compounds	Reported biological actions	References
Turmeric	*Curcuma longa*	Curcumin	Anti-inflammatory, antioxidant, apoptosis induction	11–12
Ashwagandha	*Withania somnifera*	Withanolides	Antiproliferative, apoptosis induction	13
Tulsi	*Ocimum tenuiflorum*	Eugenol, rosmarinic acid	Antioxidant, anti-inflammatory	14
Neem	*Azadirachta indica*	Limonoids, flavonoids	Antiproliferative, apoptosis induction	16
Guduchi	*Tinospora cordifolia*	Alkaloids, diterpenoids	Immunomodulatory	17
Amalaki	*Phyllanthus emblica*	Polyphenols, vitamin C	Antioxidant, anti-inflammatory	18
Rasona	*Allium sativum*	Allicin, sulfur compounds	Antioxidant, detoxification enzyme activation	19

Shunthi	*Zingiber officinale*	Gingerols, shogaols	Anti-inflammatory, antiproliferative	20
Guggulu	*Commiphora mukul*	Guggulsterones	Anti-inflammatory, apoptosis induction	22

3.4 Molecular Mechanisms in Cancer Prevention

The phytochemicals listed in Table 3 exert anticancer effects through four principal mechanisms, illustrated in Figure 1.

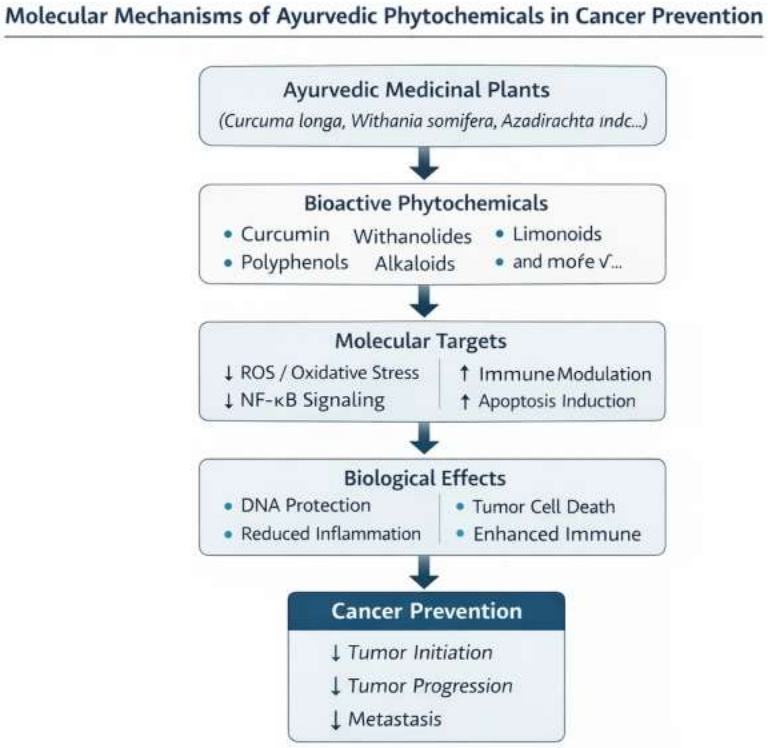

Figure 1: Schematic representation of molecular pathways through which phytochemicals derived from Ayurvedic medicinal plants may contribute to cancer prevention.

3.4.1 Antioxidant Activity

Oxidative stress drives cancer initiation through DNA damage and genomic instability. Polyphenols and flavonoids present in several Ayurvedic plants (Table 3) neutralize reactive oxygen species and protect cellular components from oxidative damage[18-21].

3.4.2 Anti-inflammatory Effects

Chronic inflammation promotes tumor initiation and progression. Compounds such as curcumin and guggulsterone inhibit the NF-kB signaling pathway, reducing pro-inflammatory mediators implicated in cancer development[11,22,28.]

3.4.3 Induction of Apoptosis

Bioactive compounds including withanolides and limonoids induce programmed cell death in transformed cells across multiple tumor models[13,16].

3.4.4 Immunomodulatory Activity

Immunomodulatory herbs such as Tinospora cordifolia stimulate host immune responses that may support immune-mediated tumor suppression[17]

Many of these herbs act through multiple mechanisms simultaneously, consistent with the multi-target therapeutic approach which is characteristic of Ayurvedic medicine.

4. DISCUSSION

4.1 Ayurvedic Lifestyle Strategies in Cancer Prevention

The findings of this review suggest that Ayurvedic lifestyle practices play a significant role in cancer prevention by influencing key biological pathways involved in carcinogenesis. Structured daily and seasonal routines, namely *Dinacharya* and *Ritucharya*, promote circadian regularity, balanced nutrition, and physical activity - factors that modern chronobiology and epidemiological research have linked to reduced cancer risk. Disruption of circadian rhythms is now recognized to contribute to hormonal imbalance, metabolic dysregulation, and impaired immune surveillance, providing biological evidence to the Ayurvedic emphasis on routine.

In addition, mind–body practices such as yoga and meditation contribute to stress regulation, which is increasingly recognized as an important factor in cancer development through its effects on inflammation and immune function. Collectively, these lifestyle interventions reflect a proactive and continuous approach to maintaining physiological balance and reducing disease susceptibility.

4.2 Herbal Strategies: Dietary Botanicals and Rasayana

Ayurvedic herbal strategies, including both dietary botanicals and *Rasayana* interventions, represent a complementary dimension of cancer prevention. Dietary principles centered on Sattvic nutrition—characterized by plant-based, minimally processed foods enriched with spices—closely parallel modern dietary recommendations. Common dietary botanicals such as *Rasona* (*Allium sativum*) and *Shunthi* (*Zingiber officinale*) contain bioactive compounds with antioxidant and anti-inflammatory properties, suggesting that routine dietary intake itself may contribute to chemopreventive effects.

Rasayana therapy extends this preventive approach by enhancing physiological resilience through immunomodulation, rejuvenation, and maintenance of systemic homeostasis. Unlike conventional single-target chemopreventive agents, *Rasayana* herbs exhibit multi-target activity, including antioxidant effects, modulation of inflammatory pathways such as NF-κB, induction of apoptosis, and immune enhancement. This broad-spectrum activity is particularly relevant given the multi-step nature of carcinogenesis and supports the concept of Rasayana as a potential multi-target chemopreventive strategy.

4.3 Translational Challenges and Limitations

Despite the conceptual and mechanistic alignment between Ayurvedic principles and modern cancer biology, significant gaps remain in clinical translation. Most evidence supporting the anticancer potential of Ayurvedic herbs is derived from in vitro and animal studies, with limited well-designed human trials evaluating their preventive efficacy.

Bioavailability remains a critical challenge; for example, curcumin demonstrates limited oral absorption, which may restrict its clinical applicability without advanced delivery systems. Additionally, Ayurveda traditionally utilizes polyherbal formulations based on synergistic interactions, whereas modern research has largely focused on isolated compounds, leaving an important aspect of Ayurvedic therapeutics insufficiently explored.

This review also has inherent limitations, including reliance on predominantly preclinical evidence, variability in herbal preparation and standardization, selective inclusion of representative herbs and practices, and the potential for publication bias.

4.4 Future Directions

Advancing Ayurvedic strategies for cancer prevention into evidence-based practice will require well-designed clinical trials evaluating both herbal formulations and lifestyle-based interventions. Pharmacokinetic studies to improve bioavailability of key phytochemicals and systematic investigation of polyherbal synergies are also necessary.

Importantly, future research should extend beyond isolated compounds to evaluate the combined effects of diet, lifestyle, and herbal interventions as practiced in Ayurveda. Interdisciplinary collaboration between Ayurvedic practitioners, biomedical researchers, and oncologists will be essential to develop integrative and scientifically validated preventive approaches.

5. CONCLUSION

This review highlights that Ayurvedic preventive healthcare, through its integrated emphasis on lifestyle regulation, dietary practices, and *Rasayana*-based interventions, addresses key biological processes associated

with increased cancer risk. Practices such as structured daily and seasonal routines support circadian balance and metabolic regulation, while Sattvic dietary patterns and mind–body interventions contribute to the modulation of chronic inflammation and maintenance of immune function - factors closely linked to carcinogenesis.

Ayurvedic medicinal plants, including both dietary botanicals and Rasayana herbs, provide a continuous source of bioactive compounds that may help regulate oxidative stress, inflammatory responses, and immune homeostasis. These interventions appear to support the maintenance of a physiological environment that is less conducive to the initiation and progression of malignancy.

This systems-oriented and lifestyle-based approach complements modern preventive oncology by emphasizing long-term risk reduction and physiological resilience. However, the current evidence remains largely preclinical, and well-designed clinical studies are required to establish the preventive efficacy of these strategies in human populations. Standardization of herbal preparations and evaluation of combined lifestyle–dietary interventions will be important for future research.

Overall, the integration of Ayurvedic principles with contemporary biomedical understanding may offer a holistic and sustainable framework for cancer prevention.

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