



Review Article

ROLE OF AYURVEDA AS AN ADJUVANT THERAPY IN BREAST CANCER: AN INTEGRATIVE REVIEW OF PATHOGENESIS, TOXICITY MANAGEMENT, PSYCHONEUROIMMUNOLOGY, AND SYSTEMIC RESTORATION

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ABSTRACT

Breast cancer remains the most prevalent malignancy among women worldwide, exhibiting rising incidence and mortality despite advances in early detection and treatment. In 2022, an estimated 2.3 million new cases and 670,000 deaths were recorded globally, with projections suggesting continued increases through 2050 due to demographic transitions and persistent risk factors. Ayurvedic literature historically describes proliferative masses such as *Granthi* and *Arbuda*, which classical authorities correlate with tumorigenic conditions involving vitiation of the *Tridosha* (*Vata*, *Pitta*, *Kapha*) and *Dhatu*s (tissue elements). Modern integrative oncology research identifies potential adjunctive therapeutic roles for Ayurvedic herbs and mind-body practices; however, rigorous clinical data remain limited, necessitating systematic investigation. This article synthesizes epidemiological data, Ayurvedic pathophysiology, and current integrative research to inform evidence-based frameworks for further study and clinical application.

INTRODUCTION

Breast cancer is a heterogeneous group of malignant neoplasms originating from the epithelial tissue of the mammary gland. Tumorigenesis results from accumulated genetic and epigenetic alterations leading to uncontrolled cell proliferation, invasion, and eventual metastasis. Contemporary disease models identify hormone-dependent and hormone-independent molecular subtypes, impacting prognosis and therapeutic response [2].

In classical Ayurvedic texts, abnormal growths are described under the terms *Granthi* (benign swellings) and *Arbuda* (malignant tumors), with detailed etiopathogenesis attributed to *Dosha* imbalance, impaired *Agni* (digestive and metabolic fire), and *Dhatu* vitiation, resulting in dysfunctional tissue homeostasis [3].

These foundational principles provide a conceptual framework for correlating Ayurvedic pathology with modern oncological understanding.

Epidemiology

Global Incidence and Mortality

Breast cancer has surpassed all other malignancies in incidence among women, with approximately 2.3 million cases diagnosed in 2022, representing the highest number for any cancer type globally [1]. In the same period, about 670,000 women died from the disease, making breast cancer a leading cause of cancer mortality among women [1].

Trends indicate a consistent rise in incidence globally, with estimated annual increases of 3–5% in many countries, including high- and middle-income regions [2].

The World Health Organization (WHO) reports that breast cancer is the most frequently diagnosed cancer in 157 of 185 countries, driven by demographic aging, reproductive risk profiles, and lifestyle exposures [1]. According to WHO and International Agency for Research on Cancer (IARC) projections, if current trends continue, new breast cancer cases could rise by approximately 38% and related deaths

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by 68% by 2050, underscoring the growing global burden [4].

Regional Variations and Risk Factors

Breast cancer incidence and mortality exhibit significant geographic heterogeneity. Incidence rates tend to be higher in high-income countries, partly due to widespread screening, reproductive patterns such as delayed childbearing, and lifestyle factors [5]. Conversely, low- and middle-income countries often display lower incidence but higher mortality due to late-stage diagnosis and limited access to comprehensive care [1].

Modifiable risk factors associated with breast cancer include obesity, alcohol consumption, physical inactivity, and reproductive behaviors, while non-modifiable factors encompass age, female sex, and genetic predispositions such as BRCA mutations [6].

Patterns in Specific Populations

Although rare, breast cancer also occurs in men, accounting for approximately 0.5–1% of all breast cancer cases [1]. Epidemiological analyses further reveal that early-onset breast cancer among younger women is increasing in some regions, prompting consideration of revised screening strategies and early detection policies [7].

Research in Mind, Body, and Spirit in Relation to Cancer

There is increasing scientific recognition that cancer progression and patient outcomes are not determined solely by tumor biology but are profoundly influenced by psychological, neuroendocrine, and immunological factors. The interrelationship between mental states, emotional stressors, and physiological processes is now a major focus of integrative cancer research, giving rise to disciplines such as psychoneuroimmunology and psychopharmacology. These fields examine how cognitive and emotional processes modulate immune surveillance, inflammatory pathways, and neuroendocrine signaling, thereby influencing carcinogenesis, tumor growth, and metastasis.

Experimental and clinical studies demonstrate that psychological stress alters hypothalamic-pituitary-adrenal (HPA) axis activity and sympathetic nervous system output, leading to sustained elevations in cortisol, catecholamines, and pro-inflammatory cytokines. These neuroendocrine mediators can suppress natural killer (NK) cell activity, impair cytotoxic T-cell responses, and promote angiogenesis and tumor invasiveness through β -adrenergic signaling pathways [8,9].

Green et al. (2013) provided a comprehensive framework describing how chronic stress and

depression influence cancer biology via immune dysregulation and neuroendocrine imbalance, establishing psychoneuroimmunology as a mechanistically plausible contributor to cancer progression rather than a purely psychosocial correlate [10].

Psychosocial Stress, Depression, and Cancer Outcomes

Epidemiological and clinical investigations consistently demonstrate associations between chronic psychological stress, depression, and adverse cancer outcomes. Populations exposed to prolonged stress exhibit higher cancer incidence, increased mortality, and poorer prognosis across multiple malignancies, including breast cancer.

A large meta-analysis evaluating psychosocial stressors revealed an increased incidence of lung cancer and reduced survival among patients with cancers of the head and neck, breast, lung, and lymphoid or hematopoietic tissues [11]. Depression has similarly been associated with increased cancer-specific mortality, reduced treatment adherence, and diminished quality of life.

Mechanistically, stress-induced activation of adrenal hormones such as cortisol and epinephrine influences tumor biology by modulating inflammatory gene expression, enhancing epithelial-mesenchymal transition, and promoting metastatic potential [12].

These effects are particularly pronounced in underserved and socioeconomically disadvantaged populations, where chronic stress exposure is compounded by delayed diagnosis, inadequate access to care, and reduced psychosocial support [13].

Ayurvedic Interpretation of Mind-Body Interactions

Ayurveda has long recognized the inseparability of *Sharira* (body) and *Manas* (mind) in disease causation and progression. Classical texts describe psychological disturbances such as *Chinta* (anxiety), *Shoka* (grief), *Bhaya* (fear), and *Krodha* (anger) as potent etiological factors capable of vitiating *Doshas*, weakening *Agni*, and depleting *Ojas*, the substratum of immunity and vitality.

The Charaka Samhita explicitly states that mental disturbances impair digestive and metabolic function, leading to systemic vulnerability and disease chronicity (Charaka Samhita, Sutrasthana 25/40–41) [14]. In the context of malignancy, persistent psychological stress may therefore be conceptualized as a contributor to *Ojokshaya*, increasing susceptibility to treatment toxicity, infection, cachexia, and recurrence.

Yoga, Meditation, and Cancer-Related Outcomes

Mind-body interventions derived from yoga and meditation have been extensively investigated for their role in cancer care, particularly as adjuncts to conventional therapy. As of August 2022, PubMed indexed over 7,000 publications on *Yoga*, including more than 700 studies specifically addressing *yoga* and cancer, and approximately 878 publications examining meditation in oncology [15].

A randomized controlled trial involving 159 patients with various cancer types evaluated the effects of an eight-week yoga therapy program. The intervention produced statistically significant reductions in depression and fatigue, with the most pronounced benefits observed among breast cancer patients [16]. These findings support the role of yoga in modulating psychological distress and treatment-related symptom burden.

Yoga has also been incorporated into multimodal Ayurvedic nutrition and lifestyle intervention programs for breast cancer survivors. A feasibility study assessing such an integrative approach demonstrated improvements in fatigue, sleep quality, anxiety, depression, and perceived stress, suggesting clinically meaningful benefits warranting further evaluation in randomized controlled trials [17].

Additionally, a pilot study investigating yoga-based interventions in obesity—a known risk factor for breast cancer—provided important methodological insights for future Ayurvedic research, highlighting feasibility, adherence, and outcome measurement strategies applicable to integrative oncology trials [18].

Meditation, Quality of Life, and Biological Correlates

Meditation-based interventions have also been studied in breast cancer populations. A single-blind randomized controlled trial involving 130 breast cancer patients assessed the impact of Transcendental Meditation (TM) as an adjunct to standard care. Quality-of-life outcomes measured using the Functional Assessment of Cancer Therapy–Breast (FACT-B) scale demonstrated significant improvements in the meditation group compared with standard care alone [19].

Beyond subjective outcomes, observational and experimental studies suggest that long-term meditation practice may influence biological markers associated with stress regulation and immune function. A survey examining medical care utilization among TM practitioners reported a 55.4% reduction in hospital admissions for tumors compared with matched controls within the same insurance system [20].

Recent molecular studies have explored stress-related gene expression profiles in peripheral blood mononuclear cells of long-term meditation practitioners, identifying differential expression of genes involved in inflammatory regulation, oxidative stress response, and immune surveillance. These findings provide a plausible biological basis for the observed clinical benefits and support further investigation into meditation-induced epigenetic and immunological modulation in cancer survivorship.

Pathophysiology: A Comparative Biological Perspective

Modern Biological Perspective: Genetic Failure, Cellular Dysregulation, and Metastasis

The human body is a highly dynamic biological system composed of approximately 28–30 trillion cells, maintained through tightly regulated processes of cell division, differentiation, senescence, and apoptosis. In healthy adults, an estimated 300–330 billion cells are replaced daily, primarily through stem-cell-driven regeneration in tissues such as the gastrointestinal epithelium, hematopoietic system, and epidermis [22].

Cancer arises when the genetic and epigenetic mechanisms governing these processes fail. Accumulation of DNA damage, ineffective repair mechanisms, and dysregulation of cell-cycle checkpoints result in uncontrolled cellular proliferation and resistance to apoptosis. Tumor suppressor genes such as TP53, often referred to as the “guardian of the genome,” play a central role in maintaining genomic integrity by halting the cell cycle or inducing apoptosis in response to DNA damage. Loss or mutation of TP53 function permits survival and replication of genetically unstable cells, facilitating malignant transformation [23].

In breast cancer, genetic alterations may be inherited or acquired. Germline mutations in BRCA1 and BRCA2 account for approximately 5–10% of breast cancer cases and are associated with early onset and aggressive disease phenotypes. However, the majority of cases arise from acquired mutations driven by hormonal exposure, metabolic dysregulation, chronic inflammation, oxidative stress, and environmental factors [24].

As tumors progress, malignant cells acquire additional capabilities, including angiogenesis, immune evasion, and metastatic dissemination. The metastatic cascade involves epithelial-mesenchymal transition (EMT), degradation of extracellular matrix, intravasation, survival in circulation, extravasation, and colonization of distant organs. These processes are profoundly influenced by systemic factors such as

inflammation, stress hormones, and immune competence [25].

Molecular Subtypes and the Burden of Triple-Negative Breast Cancer

Breast cancer is molecularly heterogeneous and is broadly classified into subtypes based on the expression of estrogen receptors (ER), progesterone receptors (PR), and human epidermal growth factor receptor 2 (HER2). These molecular distinctions determine prognosis and guide therapeutic strategies.

Triple-Negative Breast Cancer (TNBC) lacks expression of ER, PR, and HER2, rendering it unresponsive to hormonal and HER2-targeted therapies. TNBC is characterized by aggressive clinical behavior, higher rates of recurrence, and poorer overall survival compared with hormone receptor-positive subtypes.

In the Indian population, TNBC prevalence is notably higher than in Western cohorts, with reported rates ranging from **6.7% to 27.9%** of all breast cancer cases. TNBC in India is frequently associated with younger age at diagnosis, high-grade tumors, and advanced stage at presentation, necessitating aggressive chemotherapy regimens that further increase treatment-related toxicity [26,27].

Ayurvedic Perspective: *Arbuda*, *Granthi*, and *Tridosha* Vitiation

Classical Ayurvedic texts describe neoplastic conditions under the entities *Granthi* (localized, relatively benign nodular swellings) and *Arbuda* (large, deep-seated, progressively enlarging malignant tumors). The Charaka Samhita provides a detailed description of *Arbuda*, characterizing it as firm, immobile, minimally painful in early stages, and resistant to spontaneous resolution (Charaka Samhita, Cikitsasthana 12/70–74) [28].

From an Ayurvedic standpoint, *Stana Arbuda* (mammary malignancy) is not regarded as a localized disorder but as a manifestation of systemic pathology. Its etiopathogenesis involves chronic vitiation of *Kapha Dosha*, responsible for mass formation and tissue proliferation, in conjunction with *Vata Dosha*, which governs cellular movement, invasion, and dissemination. *Pitta Dosha*, particularly when associated with *Rakta*, contributes to inflammatory changes, metabolic instability, and tissue damage.

At the tissue level, *Arbuda* involves derangement of *Rakta Dhatu* and *Mamsa Dhatu*, with progressive impairment of *Agni* leading to accumulation of *Ama*-metabolic toxins that obstruct microchannels (*Srotas*). This obstruction creates a hypoxic, inflammatory internal milieu conducive to

abnormal tissue growth and resistance to physiological regulation [29].

Correlation Between Modern Oncology and Ayurvedic Concepts

The Ayurvedic description of impaired *Agni* and *Ama* accumulation bears conceptual parallels to modern understandings of metabolic dysregulation, chronic inflammation, and tumor microenvironment remodelling. Persistent low-grade inflammation, altered glucose and lipid metabolism, and immune dysfunction are now recognized as hallmarks of cancer progression and therapeutic resistance [30].

Similarly, the Ayurvedic emphasis on *Ojas*-the essence of all seven Dhatus and the substratum of immunity-corresponds to modern concepts of immune competence and systemic resilience. Depletion of *Ojas* (*Ojokshaya*) manifests clinically as fatigue, cachexia, susceptibility to infection, and poor tolerance to cytotoxic therapy, features commonly observed in advanced cancer patients and those undergoing intensive chemotherapy [31].

Thus, while differing in epistemology and terminology, Ayurveda and modern oncology converge on the recognition that malignancy reflects not only localized cellular abnormalities but also profound systemic derangement involving metabolism, immunity, and psychophysiological balance.

The Challenge of Conventional Therapy: Toxicity and Cellular Turnover

The “Bystander Effect” of Cytotoxic Therapies

Conventional cancer therapies, particularly chemotherapy and radiotherapy, are designed to target rapidly dividing malignant cells. However, these modalities lack absolute specificity, resulting in collateral damage to healthy tissues characterized by high cellular turnover. This phenomenon, often termed the “bystander effect,” significantly contributes to treatment-related morbidity and compromised quality of life.

The gastrointestinal mucosa is one of the most rapidly renewing tissues in the human body, with epithelial cells undergoing complete turnover every 5–7 days. Chemotherapy-induced injury to this tissue results in mucositis, nausea, vomiting, diarrhea, anorexia, and impaired nutrient absorption. These manifestations contribute to malnutrition, weight loss, and metabolic instability, which may necessitate dose reduction or treatment interruption [32].

Similarly, the hematopoietic system, responsible for the continuous production of erythrocytes, leukocytes, and platelets, is highly vulnerable to cytotoxic injury. Myelosuppression leads

to anemia, fatigue, neutropenia, thrombocytopenia, and increased susceptibility to infections. Alopecia results from damage to hair follicle stem cells, further compounding psychological distress and diminished self-image [33].

Ayurvedic Interpretation: *Ojokshaya* and Systemic Depletion

In Ayurvedic physiology, the cumulative toxicities of chemotherapy and radiotherapy are conceptualized as *Ojokshaya*, the depletion of *Ojas*, which represents the final essence of all seven *Dhatus* and the biological substrate of immunity, vitality, and resilience. Classical texts describe *Ojas* depletion as resulting in fatigue, emaciation, fearfulness, impaired healing, and vulnerability to disease (Charaka Samhita, *Sūtrasthana* 17/74–75) [34].

Persistent *Ojokshaya* during cancer treatment manifests clinically as cachexia, recurrent infections, reduced tolerance to chemotherapy, delayed recovery, and increased likelihood of disease recurrence. From this perspective, therapeutic strategies aimed at preserving and restoring *Ojas* are essential to improving overall outcomes and sustaining treatment continuity.

Ayurveda as Adjuvant Therapy: Therapeutic Protocols

Metabolic Restoration: *Agnidipana* and *Amapacana*

Restoration of metabolic integrity constitutes the foundational step in Ayurvedic adjuvant care. *Agnidipana* (enhancement of digestive and metabolic fire) and *Amapacana* (elimination of metabolic toxins) are employed to correct impaired digestion, reduce systemic inflammation, and facilitate efficient nutrient assimilation.

By improving Agni function, these interventions support tissue repair, enhance drug tolerance, and mitigate gastrointestinal toxicity associated with chemotherapy. Contemporary biomedical parallels include improved metabolic efficiency, reduced inflammatory burden, and enhanced bioavailability of nutrients essential for hematopoietic and immune recovery [35].

Bio-Purification: *Shodhana* and Modified Panchakarma

Classical *Panchakarma* therapies aim to eliminate accumulated *Doshas* and toxins from the body. In the oncological setting, modified and gentle *Shodhana* protocols-including *Snehana* (oleation), *Swedana* (sudation), and carefully timed *Virechana* (therapeutic purgation)-are employed selectively and judiciously.

These interventions assist in reducing metabolic load, facilitating clearance of cytotoxic drug metabolites, and restoring physiological balance

without compromising patient strength. When appropriately individualized, such measures may improve treatment tolerance and reduce cumulative toxicity [36].

***Rasayana Cikitsa*: Rejuvenation and Immune Restoration**

Rasayana Cikitsa represents the Ayurvedic science of rejuvenation, longevity, and immune enhancement. *Rasayana* therapies aim to nourish *Dhatus*, enhance *Ojas*, and promote systemic resilience.

Modern scientific interpretations associate *Rasayana* effects with immunomodulation, antioxidant activity, hematopoietic recovery, and potential support of stem-cell function. In the cancer context, *Rasayana* interventions are particularly relevant for reversing *Ojokshaya*, mitigating fatigue, supporting marrow recovery, and improving functional capacity during and after chemotherapy [37].

Psychosocial and Lifestyle Interventions *Satvavajaya Cikitsa* (Psychotherapeutic Intervention)

Cancer diagnosis and treatment impose profound psychological stress, often manifesting as anxiety, depression, fear of recurrence, and existential distress. *Satvavajaya Cikitsa*, the Ayurvedic approach to mental health, employs counseling, cognitive regulation, meditation, *Pranayama*, and *Yoga* to stabilize mental states and enhance psychological resilience.

By modulating stress responses and reducing neuroendocrine dysregulation, *Satvavajaya* interventions contribute to improved immune function, reduced cortisol levels, and enhanced quality of life, aligning closely with principles of psychoneuroimmunology [38].

Preventive and Maintenance Lifestyle Measures

Epidemiological evidence suggests that approximately 42% of cancers are potentially preventable through lifestyle modification. Ayurvedic preventive strategies emphasize avoidance of *Viruddha Ahara* (incompatible diets), processed foods, alcohol, tobacco, and environmental toxins, alongside regular physical activity and plant-forward nutrition.

Such measures reduce metabolic stress, chronic inflammation, and recurrence risk while supporting long-term survivorship and overall well-being [39].

Integrating Systems: The Hub-and-Spoke Model

A hub-and-spoke healthcare model provides a pragmatic framework for integrating modern oncology with Ayurvedic adjuvant care. Specialized urban centers (hubs) deliver advanced diagnostics,

surgery, chemotherapy, radiotherapy, and targeted therapies, while peripheral centers (spokes) focus on screening, follow-up, lifestyle modification, psychosocial support, and Ayurvedic interventions.

This model addresses urban-rural disparities, enhances accessibility, and ensures continuity of holistic cancer care, particularly in resource-limited settings [40].

Limitations and Future Directions

Despite strong theoretical coherence and emerging supportive evidence, significant gaps remain in integrative oncology research. There is a pressing need for:

- Large-scale randomized controlled trials
- Standardized integrative treatment protocols
- Biomarker-based outcome assessment
- Personalized approaches aligning *Prakrti* with molecular oncology

Addressing these limitations will be essential for mainstream adoption of Ayurveda as a scientifically validated adjuvant system in cancer care.

CONCLUSION

Breast cancer is a multifactorial disease shaped by genetic, metabolic, immunological, and psychosocial determinants. While modern oncology effectively targets tumor biology, Ayurveda focuses on fortifying the host. Through metabolic correction, immune rejuvenation, and mind-body regulation, Ayurveda offers a scientifically plausible, culturally congruent, and patient-centered adjuvant framework.

Integrating Ayurvedic principles with standard oncological care has the potential to reduce treatment toxicity, enhance quality of life, improve resilience, and support holistic recovery, representing a meaningful evolution toward truly integrative breast cancer management.

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