



Received on 17 November 2025; received in revised form, 13 May 2026; accepted, 24 May 2026; published 01 July 2026

HERBS AS A LIFELINE IN STRESS MANAGEMENT AND INSOMNIA

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Keywords:

Herbs, Stress, Insomnia, HPA axis, GABAergic, Serotonin, Anxiety

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ABSTRACT: Stress and insomnia are among the most prevalent lifestyle disorders globally which affects mental and physical well-being chronic stress and insomnia are strongly linked to depression, cardiovascular disease, obesity, and weakened immune function. The growing incidence highlights an urgent need for safe, effective, and holistic treatment strategies such as herbal interventions to manage these interrelated conditions. Conventional therapies often provide temporary relief but may cause dependency and side effects. Herbal medicines offer a safer, natural, and holistic approach to managing these conditions. This review highlights globally recognized herbs used in stress and insomnia management across traditional systems such as Ayurveda, Traditional Chinese Medicine, and Western herbalism. Adaptogenic herbs like *Withania somnifera* (Ashwagandha), *Panax ginseng*, and *Ocimum sanctum* help regulate the hypothalamic–pituitary–adrenal (HPA) axis and reduce cortisol levels. Sedative herbs including *Valeriana officinalis* (Valerian), *Matricaria chamomilla* (Chamomile), and *Lavandula angustifolia* (Lavender) promote relaxation through GABAergic and serotonergic modulation. These herbs also exhibit antioxidant and neuroprotective actions that enhance mental resilience and sleep quality. Thus, herbal remedies worldwide act as a lifeline in stress and insomnia management, offering a safe and sustainable alternative to synthetic drugs.

INTRODUCTION: In today's fast-paced world, Stress and Insomnia have become major health challenges. Stress and Insomnia have emerged as major public health concerns in the modern era, affecting millions of individuals across all age groups¹. According to the World Health Organization (WHO), nearly 30–45% of adults experience sleep-related disturbances, and over 70% report symptoms of psychological stress at some point in their lives. The prevalence of insomnia ranges from 10–30% in the general population.

In developing countries, urbanization, occupational pressure, and lifestyle changes have further intensified the burden of stress-induced disorders. In India, studies estimate that one in three adults suffers from significant sleep disturbances, while similar patterns are observed in China, the United States, and Europe. Chronic Stress disrupts the hypothalamic pituitary adrenal (HPA) axis, leading to hormonal imbalance, anxiety, and fatigue, while Persistent Insomnia impairs cognitive performance, mood, and overall quality of life.

Conventional pharmacological treatments such as Benzodiazepines and Anti-depressants, though effective in the short term, are often associated with adverse effects, tolerance, and dependence^{2, 3}. Nowadays, there has been a growing shift toward herbal and natural therapies as safer, sustainable alternatives for managing stress and insomnia. Herbal and natural therapies are booming field in

	<p style="text-align: center;">DOI: 10.13040/IJPSR.0975-8232.17(7).2036-46</p>
	<p style="text-align: center;">This article can be accessed online on www.ijpsr.com</p>
<p>DOI link: https://doi.org/10.13040/IJPSR.0975-8232.17(7).2036-46</p>	

the pharmaceutical production. Medicinal plants possess adaptogenic, anxiolytic, and sedative properties that act on neuroendocrine and neurotransmitter pathways, helping the body restore physiological balance⁴. Globally, traditional medical systems including Ayurveda, Traditional Chinese Medicine (TCM), European Herbalism, and Native American practices have long utilized herbs such as *Withania somnifera* (Ashwagandha), *Panax ginseng*, *Valeriana officinalis* (Valerian), and *Matricaria chamomilla* (Chamomile) for promoting relaxation and mental well-being⁵.

This review aims to explore the global perspective of herbal remedies in stress management and insomnia, emphasizing their active constituents, mechanisms of action, and therapeutic significance in promoting holistic health⁶.

Pathophysiology of Stress and Insomnia: Stress and insomnia are closely interconnected neuroendocrine disorders that share overlapping biochemical and physiological mechanisms⁷.

Stress Pathophysiology⁸: Stress triggers activation of the hypothalamic–pituitary–adrenal (HPA) axis, leading to the release of corticotropin-releasing hormone (CRH) from the hypothalamus. CRH stimulates the pituitary gland to secrete adrenocorticotropic hormone (ACTH), which in turn stimulates the adrenal cortex to release cortisol, the primary stress hormone. Persistent activation of this axis causes hypercortisolemia, resulting in anxiety, depression, fatigue, and neuronal damage in the hippocampus. Chronic stress also activates the sympathoadrenal system, elevating catecholamines (epinephrine and norepinephrine), which increase heart rate, blood pressure, and oxidative stress⁴⁶.

Insomnia Pathophysiology^{9,10}: Insomnia is often a secondary consequence of stress. The hyperarousal model suggests that insomnia arises from excessive activation of the central nervous system, involving the HPA axis, sympathetic nervous system, and cortical excitation. Elevated cortisol and catecholamine levels interfere with the natural sleep–wake cycle, reducing slow-wave and REM sleep. Neurotransmitter imbalance also plays a key role. Decreased gamma-aminobutyric acid (GABA) and serotonin levels, along with altered

melatonin secretion from the pineal gland, contribute to difficulty initiating and maintaining sleep. Chronic insomnia, in turn, perpetuates stress, creating a vicious feedback loop that worsens both conditions¹¹.

Oxidative Stress and Neuroinflammation: Prolonged stress and insomnia increase the production of reactive oxygen species (ROS) and inflammatory cytokines (IL-6, TNF- α), leading to neuronal oxidative damage. These processes impair neuroplasticity and cognitive function, linking sleep loss with neurodegenerative risks¹².

Major Herbs and Global Perspectives in Stress Management and Insomnia: The following section summarizes key herbs from global traditional systems known for their efficacy in Stress and Insomnia management^{13,05}.

Indian (Ayurvedic) Herbs: India’s ancient Ayurvedic medicine identifies herbs that balance the “doshas” and strengthen mental resilience.

Ashwagandha (*Withania somnifera*)^{14,15,16}:

Introduction: Ashwagandha, also known as Indian ginseng or winter cherry, is a revered herb in Ayurveda recognized for its adaptogenic and rejuvenating properties. It is traditionally used to enhance physical strength, reduce stress, and improve vitality, playing a significant role in maintaining homeostasis under stress conditions.

Synonym: Indian Ginseng, Winter Cherry.

Biological Source: Dried roots and leaves of *Withania somnifera*.

Family: Solanaceae

Geographical Source: India, Middle East, parts of Africa, and Mediterranean regions.



FIG. 1: ASHWAGANDHA (*WITHANIA SOMNIFERA*)

Chemical Constituents: Withanolides (Withaferin-A, Withanolide D), Alkaloids (Somniferine, Withanine), Saponins, Sитоindosides.

Chemical Structure:

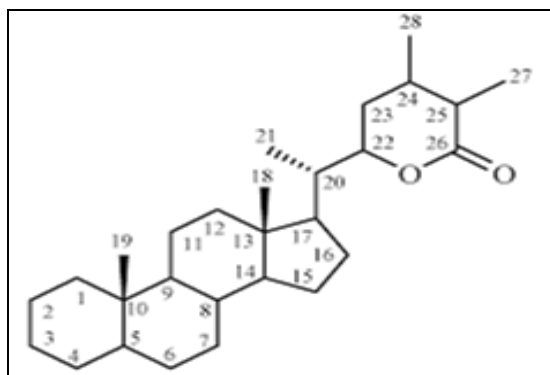


FIG. 2: WITHANOLIDES

Mechanism of Action¹⁷:

- Acts as a potent adaptogen that normalizes the HPA axis, lowering elevated cortisol levels caused by chronic stress.
- Withanolides enhance GABAergic and serotonergic signaling, producing anxiolytic and sedative effects that improve sleep quality.
- Upregulates Nrf2 and antioxidant enzymes (SOD, catalase, GSH), reducing oxidative stress in the brain.
- Restores mitochondrial energy and neuronal balance, thus improving stress resilience and sleep efficiency.
- Clinically shown to improve sleep onset latency and reduce stress-induced insomnia¹⁸

Pharmacological Action: Adaptogenic, anti-stress, anti-inflammatory, neuroprotective¹⁹ and anxiolytic.

Effect: Improves stress tolerance, sleep quality, cognitive performance, and physical endurance.

Uses: Used in stress, anxiety, insomnia, fatigue, cognitive decline, and as a rejuvenating tonic¹⁶.

Brahmi (*Bacopa monnieri*)²⁰:

Introduction: Brahmi is an ancient medicinal herb widely used in Ayurveda for its cognitive-enhancing and neuroprotective effects. Known as a “brain tonic,” it is valued for improving memory,

learning, and concentration, and for reducing anxiety and mental fatigue.

Synonym: Water hyssop

Biological Source: Whole plant of *Bacopa monnieri*

Family: Scrophulariaceae / Plantaginaceae

Geographical Source: India, Nepal, Sri Lanka, China, and Vietnam



FIG. 3: BRAHMI (*BACOPA MONNIERI*)

Chemical Constituents: Bacosides: A & B, Alkaloids (Brahmine, Herpestine), Saponins, Sterols.

Chemical Structure:

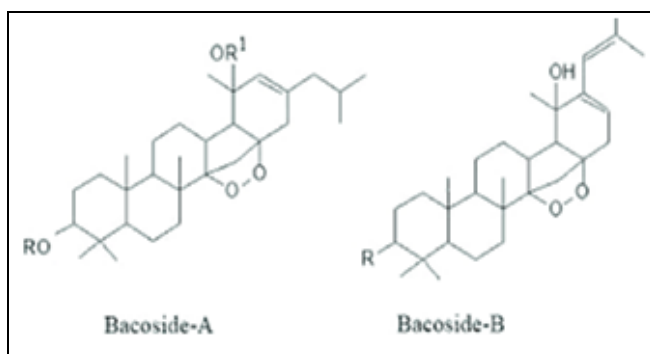


FIG. 4: BACOSIDES

Mechanism of Action²¹: Bacosides A and B enhance synaptic transmission by increasing acetylcholine and serotonin levels, supporting relaxation and cognitive stability.

- Reduces corticosterone levels and balances the HPA axis under chronic stress.
- Modulates GABA receptors, reducing anxiety-driven restlessness that disrupts sleep.

- Its antioxidant action protects hippocampal neurons from stress-induced oxidative damage.
- Improves sleep continuity and quality through central nervous system stabilization¹⁸.

Pharmacological Action: Memory enhancer, anxiolytic, neuroprotective, antioxidant²².

Effect: Improves learning ability, memory retention, and reduces anxiety.

Uses: Cognitive enhancer, Alzheimer's disease, Anxiety and Epilepsy.

Chinese (TCM) Herbs: Traditional Chinese Medicine focuses on restoring "Qi" (vital energy) and maintaining Yin-Yang balance²³.

Ginseng (*Panax ginseng*)²⁴:

Introduction: Ginseng is a well-known adaptogenic herb in traditional Chinese medicine, used to boost energy, enhance mental performance, and improve resistance to stress. It is considered a general tonic that supports immune function and overall well-being.

Synonym: Asian Ginseng, Panax Ginseng

Biological Source: Roots of *Panax ginseng*

Family: Araliaceae

Geographical Source: Korea, China, Japan, and parts of Siberia



FIG. 5: GINSENG (*PANAX GINSENG*)

Chemical Constituents: Ginsenosides (Rg1, Rb1, Rc, Rd), Polysaccharides, Peptides, Essential oils.

Chemical Structure:

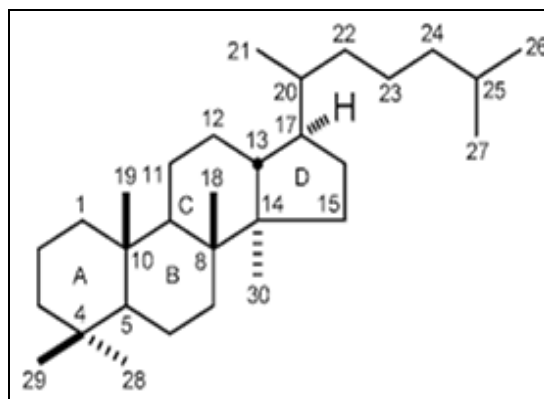


FIG. 6: GINSENOIDES

Mechanism of Action²⁵:

- Ginsenosides regulate the HPA axis, reducing excessive ACTH and cortisol during stress.
- Improves resistance to psychological and physical stress by enhancing energy metabolism and NO-mediated vasodilation.
- Balances neurotransmitters like dopamine, serotonin, and norepinephrine, reducing anxiety and fatigue-related sleep disturbances.
- Promotes neurogenesis and BDNF expression, restoring healthy circadian rhythm and sleep patterns.
- Has a biphasic action — stimulating in the day and calming under stress-induced fatigue^{26, 27}.

Pharmacological Action: Adaptogenic, antioxidant, immunostimulant, nootropic

Effect: Enhances vitality, concentration²⁸, immunity, and reduces fatigue

Uses: Stress, mental and physical exhaustion, diabetes, and immune disorders²⁹.

Ziziphus (*Ziziphus jujuba* or *Ziziphus spinosag*)³⁰:

Introduction: Ziziphus, commonly known as jujube or Chinese date, is a traditional sedative and anxiolytic herb used in Chinese and Unani medicine. It helps calm the nervous system, promote sleep, and alleviate anxiety and restlessness.

Synonym: Jujube, Chinese date

Biological Source: Seeds of *Ziziphus jujuba* or *Ziziphus spinosa*

Family: Rhamnaceae

Geographical Source: China, India, and Mediterranean regions.



FIG. 7: ZIZIPHUS (ZIZIPHUS JUJUBA OR ZIZIPHUS SPINOSA)

Chemical Constituents: Jujubosides, Flavonoids, Saponins, Triterpenes, Alkaloids.

Chemical Structure:

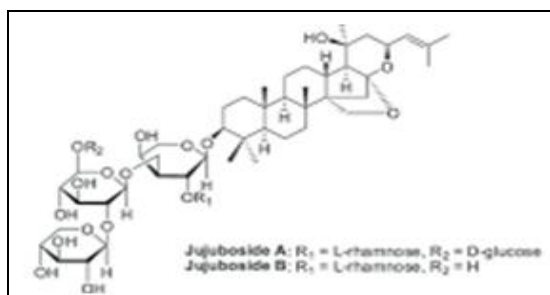


FIG. 8: JUJUBOSIDES

Mechanism of Action³¹:

- Jujubosides potentiate GABA_A receptor function, enhancing inhibitory neurotransmission that promotes calmness and sleep.
- Reduces noradrenaline levels and neuronal hyperexcitability linked to stress.
- Increases serotonin and melatonin levels, aligning sleep-wake cycles.
- Inhibits calcium influx and suppresses glutamate excitotoxicity, easing anxiety and insomnia.
- Traditionally used as a natural hypnotic to induce restful sleep³².

Pharmacological Action: Sedative, hypnotic^{33, 34}, anxiolytic, antioxidant³⁵.

Effect: Promotes relaxation, reduces anxiety and insomnia^{33, 34}.

Uses: Insomnia, anxiety, and nervous disorders.

European & Western Herbs³⁶: Europe has a long history of using herbal sedatives, many of which are also popular in modern phytotherapy.

Valerian (*Valeriana officinalis*)³⁷:

Introduction: Valerian is a popular herbal sedative used in Europe and Asia for centuries to promote sleep and relieve anxiety. Its root contains bioactive compounds that act on the central nervous system to induce calmness and relaxation.

Synonym: Garden heliotrope

Biological Source: Roots and rhizomes of *Valeriana officinalis*

Family: Valerianaceae / Caprifoliaceae

Geographical Source: Europe, North America, and Asia



FIG. 9: VALERIAN (*VALERIANA OFFICINALIS*)

Chemical Constituents: Valerenic acid, Valepotriates, Alkaloids, Flavonoids, Volatile oils

Chemical Structure:

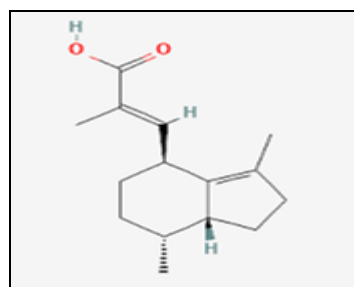


FIG. 10: VALERENIC ACID

Mechanism of Action^{38,39}:

- Valerenic acid inhibits GABA transaminase, increasing brain GABA concentration, leading to sedation and anxiolysis.
- Binds to GABA_A receptor β -subunit (benzodiazepine-like site), enhancing relaxation.
- Reduces sleep latency and improves sleep maintenance without altering REM stages.
- Slightly modulates serotonin (5-HT_{1A}) receptors to reduce anxiety-driven insomnia.
- Acts synergistically with melatonin and adenosine systems to normalize circadian rhythm⁴⁰.

Pharmacological Action: Sedative, hypnotic, antispasmodic, anxiolytic⁴¹.

Effect: Improves sleep onset⁴² and quality, reduces restlessness.

Uses: Insomnia, stress, muscle spasms, and anxiety.

Chamomile (*Matricaria chamomilla*)⁴³:

Introduction: Chamomile is a gentle, aromatic herb traditionally used for its calming, anti-inflammatory, and digestive properties. Often consumed as tea, it is widely recognized for reducing anxiety, promoting sleep, and soothing the digestive tract.

Synonym: German Chamomile

Biological Source: Dried flowers of *Matricaria chamomilla*

Family: Asteraceae

Geographical Source: Europe, North Africa, Western Asia, and India



FIG. 11: CHAMOMILE (*MATRICARIA CHAMOMILLA*)

Chemical Constituents: Apigenin, Bisabolol, Chamazulene, Flavonoids, Coumarins

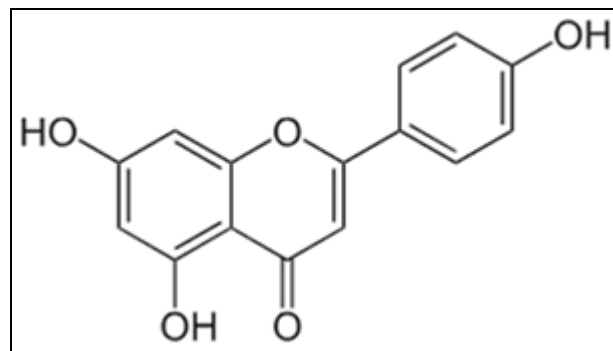
Chemical Structure:

FIG. 12: APIGENIN

Mechanism of Action^{44,45}:

- Apigenin, a key flavonoid, binds to benzodiazepine sites on GABA_A receptors, producing mild sedation.
- Modulates serotonergic and adrenergic systems to relieve anxiety and emotional tension.
- Suppresses COX-2 and iNOS, reducing neuroinflammation associated with stress-induced insomnia.
- Calms the CNS and reduces cortisol levels, promoting relaxation and sleep.
- Regular intake improves sleep onset and nighttime awakenings in mild insomnia⁴⁶.

Pharmacological Action: Sedative, anxiolytic, anti-inflammatory, antispasmodic⁴⁷.

Effect: Calms the nervous system and promotes sleep⁴⁸.

Uses: Anxiety, insomnia, digestive disturbances, and inflammation.

African Herbal Practices: African traditional medicine employs a variety of plants for psychological balance and relaxation.

Rooibos (*Aspalathus linearis*)⁴⁹:

Introduction: Rooibos, or red bush tea, is a caffeine-free herbal tea native to South Africa, prized for its antioxidant and anti-stress properties. It is commonly consumed for relaxation and to combat oxidative stress-related disorders.

Synonym: Red bush tea

Biological Source: Leaves of *Aspalathus linearis*

Family: Fabaceae

Geographical Source: South Africa (Cedarberg region)



FIG. 13: ROOIBOS (*ASPALATHUS LINEARIS*)

Chemical Constituents: Aspalathin, Nothofagin, Quercetin, Rutin, Phenolic acids.

Chemical Structure:

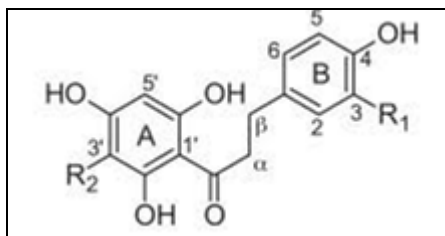


FIG. 14: ASPALATHIN AND NOTHOFAGIN

Mechanism of Action⁵⁰:

- Aspalathin and Nothofagin activate Nrf2–ARE pathway, enhancing brain antioxidant defenses and reducing stress-induced oxidative load.
- Suppresses HPA axis hyperactivity, lowering corticosterone levels.
- Elevates serotonin and dopamine, improving mood and promoting relaxation.
- Reduces oxidative stress in the hippocampus, improving sleep regulation and circadian stability.
- Caffeine-free, making it safe for use as a calming bedtime beverage.

Pharmacological Action: Antioxidant, antistress, anti-inflammatory⁵¹.

Effect: Reduces oxidative stress and anxiety.

Uses: Stress, inflammation, cardiovascular protection, and skin health.

African Basil (*Ocimum gratissimum*)⁵²:

Introduction: African basil is a tropical aromatic plant used in traditional African and Ayurvedic medicine for its antimicrobial, anti-inflammatory, and stress-relieving properties. It is known to promote mental clarity and emotional balance.

Synonym: Clove basil, African blue basil.

Biological Source: Leaves of *Ocimum gratissimum*

Family: Lamiaceae

Geographical Source: Africa, India, tropical Asia



FIG. 15: AFRICAN BASIL (*OCIMUM GRATISSIMUM*)

Chemical Constituents: Eugenol, Thymol, Ocimene, Flavonoids⁵³, Rosmarinic acid

Chemical Structure:

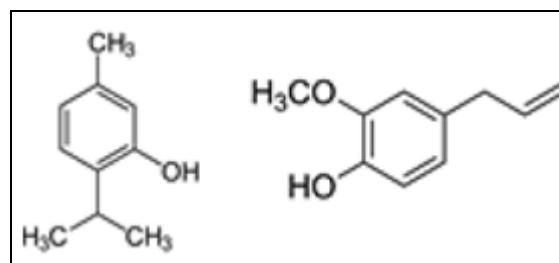


FIG. 16: THYMOL AND EUGENOL

Mechanism of Action⁵⁴:

- Eugenol and Thymol modulate GABAergic and serotonergic transmission, producing a tranquilizing effect.

- Reduces plasma cortisol and adrenaline, helping restore autonomic balance during chronic stress.
- Activates Nrf2 antioxidant pathways, reducing neuroinflammation and oxidative neuronal stress.
- Promotes dopamine stability, improving mood and mental clarity for better sleep onset.
- Traditionally used to calm the nervous system and treat insomnia in African medicine ⁵⁵.

Pharmacological Action: Adaptogenic, anxiolytic, antimicrobial

Effect: Calms nervous system and enhances mood

Uses: Stress, anxiety, infections, and inflammation

American and Native Herbal Medicine: Native American traditions and modern herbalism value plants that soothe the mind and promote rest.

Passionflower (*Passiflora incarnata*) ^{56, 57}:

Introduction: Passionflower is a traditional herbal remedy used for anxiety, insomnia, and nervous restlessness. It exerts a calming effect on the nervous system and is frequently used as a natural sedative in herbal formulations.

Synonym: Maypop

Biological Source: Aerial parts of *Passiflora incarnata*

Family: Passifloraceae

Geographical Source: South America, North America, and parts of Europe



FIG. 17: PASSIONFLOWER (*PASSIFLORA INCARNATA*)

Chemical Constituents: Harmine, Harmaline, Flavonoids (Vitexin, Isovitexin), Glycosides

Chemical Structure:

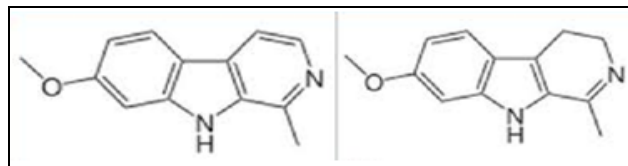


FIG. 18: HARMINE AND HARMALINE

Mechanism of Action ⁵⁸:

- Harmine and Harmaline inhibit MAO-A, increasing serotonin and dopamine levels for relaxation and sleep induction.
- Flavonoids (vitexin, isovitexin) enhance GABAergic activity, leading to CNS depression and anxiolysis.
- Inhibits GABA reuptake and transaminase, maintaining higher GABA availability in synapses.
- Decreases sympathetic overactivity, reducing heart rate and stress-induced arousal.
- Clinically shown to improve sleep quality and reduce anxiety-related insomnia ⁵⁹.

Pharmacological Action: Anxiolytic, sedative, spasmolytic ⁶⁰.

Effect: Reduces anxiety and promotes restful sleep ^{61, 62}.

Uses: Anxiety, insomnia, and nervous restlessness

Hops (*Humulus lupulus*) ⁶³:

Introduction: Hops, best known for their use in brewing beer, are also valued in herbal medicine for their sedative and anxiolytic properties. The plant's female flowers contain compounds that help induce sleep and relieve nervous tension.

Synonym: Common hops

Biological Source: Female inflorescences of *Humulus lupulus*

Family: Cannabaceae

Geographical Source: Europe, North America, Asia

FIG. 19: HOPS (*HUMULUS LUPULUS*)

Chemical Constituents: Humulone, Lupulone, Xanthohumol, Flavonoids, Essential oils.

Chemical Structure:

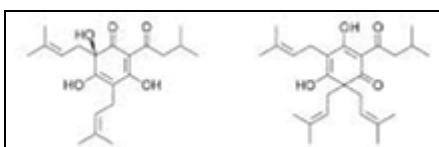


FIG. 20: HUMULONE AND LUPULONE

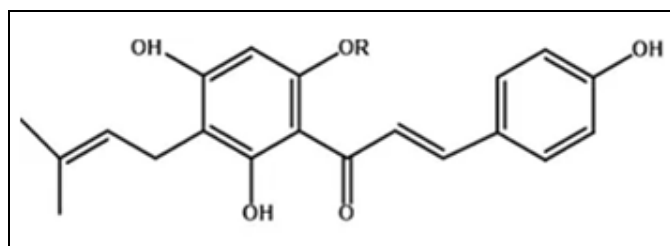


FIG. 21: XANTHOTHUMOL

Mechanism of Action⁶⁴:

- Humulone, Lupulone, and Xanthohumol act as positive modulators of GABA-A receptors, producing sedative effects.
- Regulates melatonin receptors (MT1/MT2), supporting natural circadian rhythm and sleep onset.
- 8-prenylnaringenin, a phytoestrogen, helps improve sleep and mood in menopausal women.
- Reduces CNS excitation and stress-related restlessness.
- Often used in combination with valerian for synergistic sleep enhancement.

Pharmacological Action: Sedative, hypnotic, anxiolytic, antioxidant⁶⁵.

Effect: Induces relaxation and improves sleep latency.

Uses: Insomnia, anxiety, and menopausal symptoms.

Note:

- Traditional formulations like the Ashwagandha–Brahmi^{48, 49} blend not only support cognitive resilience and stress adaptation but also promote restorative sleep, illustrating the holistic philosophy of Ayurveda.
- Similarly, Western phytotherapy utilizes combinations such as Valerian–Hops–Passionflower to target nervous tension while enhancing sleep quality and continuity.

These multilayered formulations demonstrate a dual therapeutic action, modulating neuroendocrine stress pathways and improving sleep architecture making them promising alternatives to conventional treatments.

CONCLUSION: Herbal synergy represents a powerful approach in the management of Stress and Insomnia, combining both adaptogenic and sedative properties to address the underlying physiological and psychological imbalances. Integrating such evidence-based herbal strategies can offer safe, effective, and comprehensive solutions for modern lifestyle-related challenges of Stress and Insomnia. The above content can be used for further research development.

ACKNOWLEDGEMENTS: Nil

CONFLICTS OF INTEREST: Nil

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How to cite this article:

Pokharkar D and Dhake L: Herbs as a lifeline in stress management and insomnia. *Int J Pharm Sci & Res* 2026; 17(7): 2036-46. doi: 10.13040/IJPSR.0975-8232.17(7).2036-46.

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