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Expert Consensus on Herbal Interventions for Stress, Sleep, and Immune Health: Insights From Middle Eastern, African, and Global Studies

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Abstract

Background: Sleep, stress, and immune-related concerns are increasingly prevalent in Middle Eastern and African (MEA) populations, primarily driven by limited access to preventive care. Despite widespread reliance on herbal remedies, standardized guidance on their safe and effective use remains scarce. This study aimed to establish expert consensus on the role of commonly used herbal interventions in supporting overall wellness in the MEA region.

Methods: A panel of five experts from diverse fields convened virtually to engage in an evidence-informed Delphi process. Anonymous voting and subsequent grading were used to finalize evidence-based consensus statements (≥80% agreement) on herbal interventions for stress, sleep, and immune health.

Results: Eleven statements achieved consensus, reflecting expert agreement that rising wellness challenges across the MEA region necessitate complementary options alongside conventional therapies. Supported by clinical evidence and expert perspectives, herbal interventions such as ashwagandha, rhodiola, ginseng, chamomile, valerian, lavender, lemon balm, passionflower, echinacea, and elderberry are recognized for supporting stress resilience by reducing perceived stress and anxiety, improving multiple sleep parameters, and strengthening immune function, with additional potential to reduce inappropriate antibiotic use. Combining herbals with micronutrients may enhance wellness outcomes, yet there is a need for standardized dosing and clear guidance, especially for vulnerable groups.

Conclusion: Herbal interventions offer a practical and culturally compatible option to address rising stress, sleep, and immune-related needs in the MEA region. Their potential is strengthened when combined with micronutrients, though safe use requires clearer region-specific guidance, consistent quality standards, and focused research across MEA populations.

Categories: Integrative/Complementary Medicine
Keywords: expert consensus, herbal interventions, immune health, sleep, stress

Introduction

The World Health Organization (WHO) frames health as a state of complete physical, mental, and social well-being, rather than merely the absence of disease [1]. Within this framework, sleep, stress regulation, and immune function are closely interconnected and play critical roles in maintaining overall health [2]. Disruption in any of these domains can lead to a cascade of adverse physiological and psychological outcomes, which contribute to the rising global burden of poor sleep quality, stress-related disorders, and immune dysfunction. Recent epidemiological evidence indicates that these challenges are frequently reported health concerns across Middle Eastern and African (MEA) populations, with a substantial impact on their daily functioning and quality of life [3-6].

Although conventional pharmacological therapies remain a central option for the management of these conditions, reliance on them is often constrained by challenges such as tolerance, dependence, reduced efficacy over time, and adverse effects, all of which may negatively affect patient adherence [7-9]. These limitations, together with growing interest in integrative health approaches, have prompted interest in standardized herbal options supported by scientific evidence and ongoing validation efforts [10]. Many individuals prefer herbal therapies because they are generally affordable, culturally familiar, and perceived as safer, contributing to their growing use as complementary interventions [10].

Herbal medicine has long held an established place in global health traditions and is widely used to support physical, mental, and spiritual well-being [11]. The WHO estimates that nearly 80% of the world's population uses herbal products for healthcare needs, especially in developing regions where they remain an important component of primary healthcare [12]. Given their potential anti-inflammatory, antioxidant, and antiviral properties, herbal medicines may contribute to chronic disease prevention and support overall health.

This reliance is particularly evident in the MEA region, where herbal remedies are deeply embedded in cultural practices and long-standing holistic health systems [13-15]. Within these traditions, several herbal products used across MEA communities for sleep support, stress management, and immune health have attracted growing scientific interest [16-18]. Although these botanicals have long been used in practice, research continues to evaluate their efficacy and precise underlying mechanisms of action. Despite this progress, formal scientific evidence from MEA populations remains limited and uneven. Moreover, the lack of standardized dosing protocols, variability in preparation methods, and inconsistent regulatory oversight across MEA countries contribute to uncertainty among clinicians and consumers regarding safety, quality, and efficacy. As a result, clinicians often face difficulties in providing evidence-based guidance on the integration of herbal options into wellness strategies, underscoring the need for more structured evaluation [19].

To bridge the gap between widespread traditional use and limited region-specific evidence, a panel of five experts from MEA reviewed and evaluated the available global and regional evidence on ten commonly used herbal interventions for stress, sleep, and immune health support. The evidence synthesis subsequently informed the development of consensus statements through a Delphi process. Based on current practices and available regional data, these statements offer practical, evidence-based guidance for integrating herbal approaches into broader wellness care. This paper addresses a critical need by synthesizing both global and region-specific evidence and incorporating the clinical experience of the expert panel to offer recommendations for the safe and effective use of herbal interventions in modern healthcare settings across the MEA region.

Materials And Methods

Expert panel formation and study design

A multidisciplinary panel of five experts was identified and selected based on their established research contributions and extensive professional experience. The panel included specialists in nutrition, wellness, pediatric medicine, pharmacovigilance, and clinical pharmacy from diverse regions, including Ghana and Egypt, to ensure broad regional representation and a well-rounded perspective. Drawing on their multidisciplinary expertise, the experts convened virtually on July 30, 2025, and participated in an evidence-informed Delphi process to assess current scientific insights and develop consensus statements. Through this process, the panel formulated evidence-based consensus statements regarding the use of herbal interventions for stress management, sleep enhancement, and the maintenance of immune health.

Literature review

To support the development of each consensus statement, a comprehensive literature search was conducted using tailored search strategies that combined relevant keywords and Medical Subject Headings (MeSH) aligned with each topic area. The search was performed primarily in PubMed and Embase, along with manual searches in Google Scholar, with no restrictions on publication date. Only English-language publications were considered eligible for inclusion. Additional relevant studies were identified by screening the reference lists of selected articles. After duplicate removal and eligibility assessment, a total of 166 publications were included to support the final consensus statements (Figure *1*). Details of the search strategy, along with the inclusion and exclusion criteria, are outlined in the Appendices.

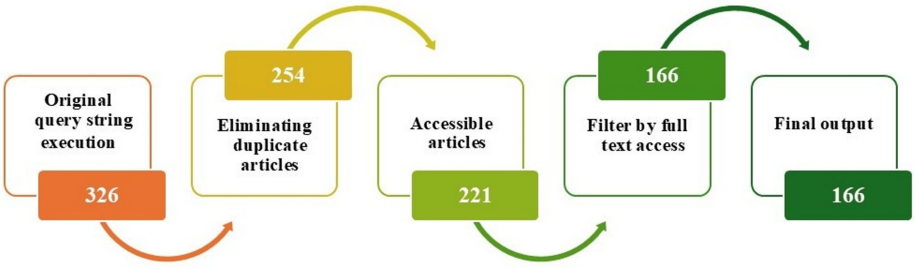


FIGURE 1: Search and selection process of articles

Figure generated using Microsoft PowerPoint (Microsoft Corporation, Redmond, Washington).

Delphi process and consensus development

A Delphi process (Figure 2) was used to develop and refine the consensus statements. Prior to the virtual meeting, all experts received pre-read materials that included draft consensus statements and the corresponding supporting evidence to ensure informed engagement in the discussions. During the virtual meeting, the panel engaged in rigorous, evidence-driven discussions. The experts reviewed the clinical data, shared their professional insights, and considered real-world healthcare scenarios relevant to the topic areas. Through this structured discussion, the draft statements were thoroughly evaluated, and key areas of agreement were identified.

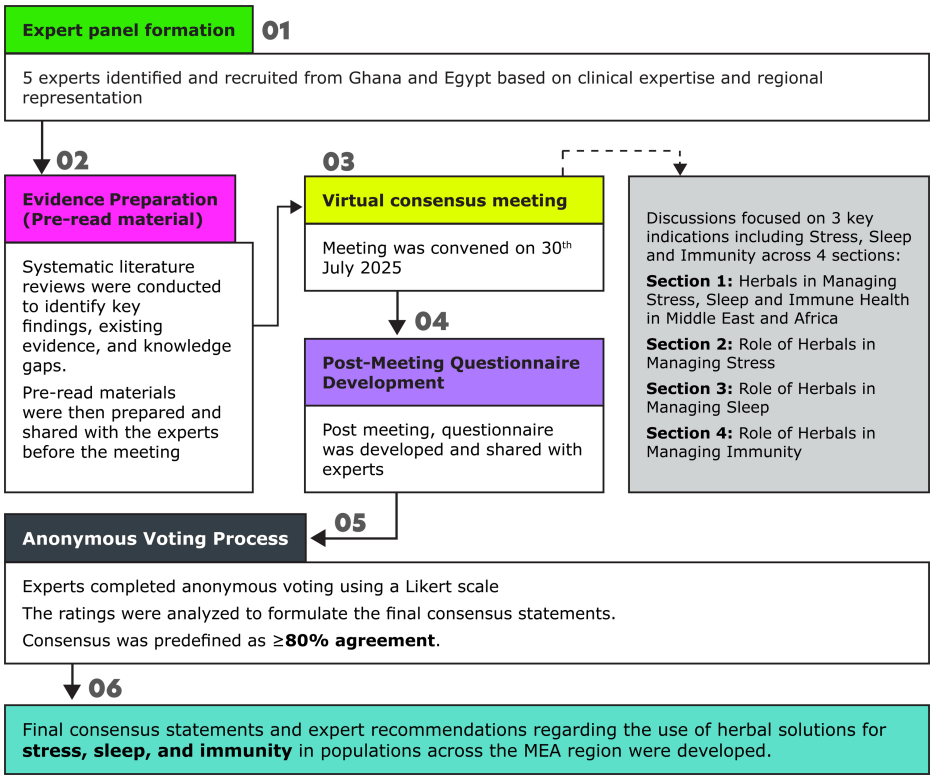


FIGURE 2: Overview of multistage expert consensus development process

This image was created using Adobe InDesign (Adobe Inc., San Jose, California).

Following the meeting, a questionnaire consisting of draft statements was developed, incorporating input from all panel members. The statements were then circulated to the panel for anonymous voting and feedback via Qualtrics (Qualtrics, LLC, Provo, Utah), ensuring unbiased assessment and transparency. The level of agreement for each statement was assessed using a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree), and consensus was defined a priori as ⩾80% agreement. The results of this voting round were used to determine the degree of consensus for each final statement.

The finalized consensus statements were subsequently graded to reflect the overall strength of supporting evidence [20]. Evidence was categorized by study design into five hierarchical levels: Level 1, high-quality randomized controlled trials (RCTs) and systematic reviews/meta-analyses; Level 2, prospective cohort and case-control studies; Level 3, cross-sectional studies; Level 4, case series; and Level 5, expert opinion and narrative reviews (Figure 3). Each statement was then assigned a rating (A-E), aligned with both the underlying evidence level and the degree of expert agreement. This structured approach, combining systematic evidence review with anonymized expert appraisal, supported the development of the final 11 consensus statements. These statements included practical considerations such as the role of herbal interventions, dosing considerations, age-related use, and guidance for vulnerable populations, particularly within the MEA region.

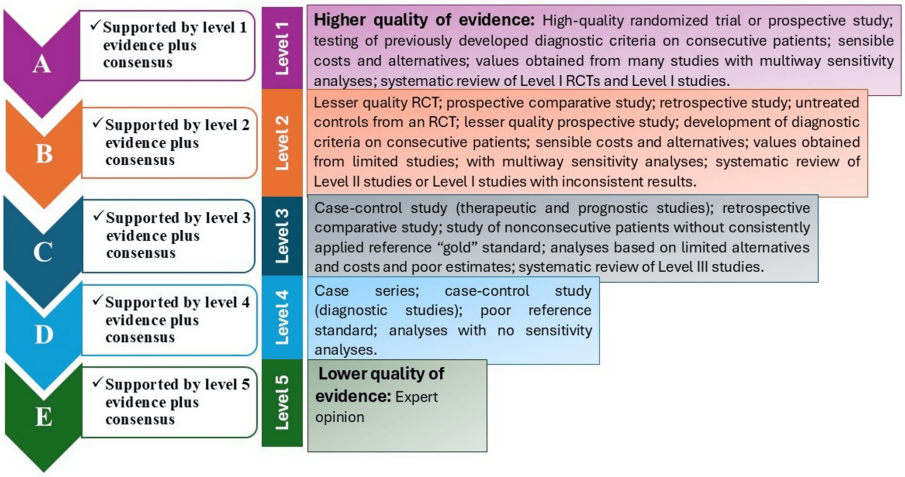


FIGURE 3: Evidence pyramid-based grading framework, depicting Levels 1-5 of evidence and the corresponding consensus strength to evaluate the quality and reliability of supporting data

RCT: randomized controlled trial. Source.

Author's own illustration based on data from [20]. Figure generated using Microsoft PowerPoint (Microsoft Corporation, Redmond, Washington).

Ethics approval

Ethical approval was not required for this study as it involved the expert panel opinions through a Delphi consensus process and did not involve any patients, related data, any biological samples, or any intervention.

Results

Consensus statement development

Using a single-round modified Delphi approach, the panel developed 11 consensus statements across four MEA-focused domains: (A) herbal interventions in managing stress, sleep, and immune health in the MEA region; (B) the role of herbal interventions in stress management; (C) sleep; and (D) immunity. The consensus statements were developed through online discussions and anonymous voting and are accompanied by the level of expert agreement, supporting evidence, and corresponding level of evidence (Table *1*). No statement was revised or reassessed, and no additional round of voting was conducted. Although a wide range of herbal remedies are used across the MEA region, this work focuses only on those supported by higher-quality evidence and validated through expert consensus. Comprehensive details of the studies evaluating these herbal interventions and their role in wellness are summarized in the Appendices.

Section 1: Herbal Interventions in Managing Stress, Sleep, and Immune Health in MEA

Statement 1: Stress, Sleep, and Immune Health Are Significant Public Health Concerns in the Middle East and Africa

Agreement: Agree: 2; Strongly Agree: 3; Level of evidence: C

Emerging epidemiological findings highlight the growing burden of stress, sleep disturbances, and immune-related health conditions across countries in the MEA region. Since anxiety generally reflects the activation of the body's stress response through shared neurobiological pathways [21,22], rising anxiety rates may serve as an important indicator of increasing stress levels in the population. Collectively, these interconnected challenges significantly contribute to the regional disease burden, adversely affect overall well-being and quality of life across diverse population groups, and represent a substantial unmet healthcare need within the region.

According to the Global Burden of Disease (GBD) 2021 study, the burden of anxiety disorders increased markedly across the Middle East and North Africa (MENA) from 1990 to 2021 [3]. In 2021, the region recorded ~4.5 million years lived with disability (YLDs), ~37.8 million prevalent cases, and ~5.7 million incident cases,

with higher prevalence reported in women. Cross-country comparisons showed disproportionately high age-standardized rates in Lebanon, Tunisia, and Iran relative to other MENA countries [3]. In addition, Saudi youth have an estimated lifetime anxiety prevalence of around 26.9% [23].

Sleep health represents a parallel and equally significant challenge, with substantial evidence showing that sleep disorders remain underdiagnosed and poorly managed across the MEA region [5,24]. Poor sleep quality is consistently reported to be high among medical students, adults, and university populations. Elevated prevalence rates have been documented in specific groups, including 60.3% of adults in Qatar [25] and between 54.43% and 69.59% among African university students [26]. Additionally, sleep disorders such as central disorders of hypersomnolence and insomnia are highly prevalent among MENA medical students, with hypersomnolence ranging from 30.9% in Jordan to 62.5% in Saudi Arabia and insomnia ranging from 30.4% in Jordan to 59.1% in Morocco [5]. These high rates are associated with multiple factors, including anxiety, depression, poor sleep hygiene, excessive internet usage, and chronic illness. Immune-related vulnerabilities are also widely reported across the MEA region, highlighting a growing public health concern driven by climate change, infectious threats, global migrations, and urbanization. At the same time, countries in the region face repeated exposure to emerging and re-emerging infectious diseases, such as Middle East respiratory syndrome coronavirus (MERS-CoV) infection, vector-borne diseases, and Rift Valley fever, all of which place additional pressure on population immune resilience [27]. Similarly, in East Africa, the climate-driven emergence of infectious diseases further highlights immune vulnerability, especially in rural and resource-limited communities [28]. Findings indicate that in nine MENA countries, adults aged ⩾60 years experienced around 9.1 million symptomatic respiratory syncytial virus (RSV) infections over a five-year period, including approximately 4.6 million cases of RSV-related lower respiratory tract disease [29]. Invasive bacterial diseases (IBD) also pose a significant public health challenge in the region, with vaccine-preventable diseases contributing notably to the burden, particularly among adults [4].

Building on clinical experience and cross-sectional evidence, the panel reported observing similar trends in routine practice, including increasing stress-related presentations, declining sleep quality, and greater susceptibility to infection. These findings further reinforce stress, sleep, and immune health as key wellness priorities across the MEA region.

Statement 2: Herbal ingredients are traditionally recognized in the Middle East and Africa region for managing stress, sleep, and immune health

Agreement: Agree: 2; Strongly Agree: 3; Level of evidence: A

For generations, communities across the MEA region have used herbal remedies as part of their daily health practices, drawing on local and regional plants to support digestion, immunity, energy, stress relief, and overall well-being [13]. Rising concerns about the adverse effects of pharmacological treatments have encouraged many individuals to shift toward natural alternatives [10]. Market analyses show that the use of herbal supplements in the MEA region is steadily increasing, with traditional preferences continuing to shape consumer choices and product availability [30]. A growing consumer shift toward natural, plant-based therapies, driven by rising health awareness and a broader focus on holistic wellness, has significantly accelerated the herbal market across the MEA region. According to reports by Market Data Forecast, the market expanded from USD 8.84 billion in 2025 to USD 10.83 billion in 2026 and is further estimated to reach USD 54.90 billion by 2034, presenting a strong growth trajectory. Notably, the United Arab Emirates (UAE) and South Africa represent the largest markets, while Saudi Arabia has been identified as the fastest-growing market within the region [31].

Across the MEA region, several traditional herbs continue to play a key role in supporting stress relief, sleep, and immune health, and many are increasingly recognized for their potential to ease anxiety, improve sleep quality, and support overall emotional well-being [32]. Adaptogenic plants like ashwagandha are used for managing stress responses [33], while aromatherapy with lavender and chamomile remains common for easing anxiety and improving sleep [34]. Additionally, botanicals such as valerian root and passionflower, and immune-supportive herbs like echinacea, are increasingly adopted as natural options for insomnia and respiratory well-being, reflecting a growing regional preference for safe, culturally rooted, plant-based solutions [35,36]. The expert panel affirmed that this growing preference for natural and preventive health practices is a key force behind the rise in herbal medicine across the MEA region, highlighting that the market is projected to double by 2035 as more people prefer familiar, plant-based remedies.

Section 2: Role of Herbals in Managing Stress

Statement 3: Rhodiola and Chamomile are known to help modulate stress in the Middle East and Africa

Agreement: Agree: 3; Strongly Agree: 1; Disagree: 1; Level of evidence: A

Rhodiola (*Rhodiola rosea*), a well-established adaptogen from the Crassulaceae family, exhibits strong anti-fatigue, anti-stress, and antidepressant properties due to its rich phytochemical profile, including salidroside, rosavins, and other phenolic compounds [37]. The adaptogenic action of these active

compounds is suggested to regulate the hypothalamic-pituitary-adrenal (HPA) axis and modulate elevated cortisol levels during stressful periods, thereby helping to restore overall homeostasis of the body [38]. Additionally, rhodiola has been reported to reduce stress-induced inflammation, lower the activity of stress-activated protein kinase (SAPK) and c-Jun N-terminal kinase (JNK), and simultaneously increase the expression of heat shock protein 70 (HSP70), which supports cellular protection and recovery [39], as illustrated in Figure *4*.

Although rhodiola products are widely used for stress relief across Europe and Asia, clinical evidence directly generated from the MEA region remains scarce. Nevertheless, a substantial body of global research suggests that rhodiola may help reduce stress-related symptom burden, improve mood, and enhance coping capacity. Systematic reviews have reported reductions in anxiety and depressive symptoms, together with overall mood improvement [39,40], although findings related to mental fatigue remain mixed because of heterogeneity in assessment methods [41].

Interventional studies have shown reductions in self-rated stress, anxiety, and depressive symptoms following rhodiola supplementation [42], as well as lower Hamilton Rating Scale for Depression (HAM-D) scores accompanied by improvements in sleep [43]. Repeated administration of a similar extract has also been associated with reduced chronic-stress-related fatigue, potentially via cortisol regulation, suggesting possible antidepressant effects [44]. An open-label, multicenter study reported improvement in burnout symptoms following rhodiola use [45].

Additional evidence indicates reductions in stress and depressive symptoms in chronic-fatigue patients, demonstrated by improved Beck Depression Inventory-II (BDI-II) scores and lower Perceived Stress Questionnaire (PSQ-R) scores [46]. Earlier observational findings also suggested that rhodiola may improve perceived life-stress symptoms [47]. The expert panel also agreed that rhodiola may help manage stress and fatigue through its antioxidant effects and its ability to support neurotransmitters like serotonin and dopamine. The panel recommended its use for a duration of 6-12 weeks, followed by a one-month break before restarting. Caution was advised for people with diabetes, as rhodiola may lower blood glucose levels, and its use during pregnancy and breastfeeding was discouraged because of limited safety data. Although rhodiola is generally considered safe, mild side effects such as dizziness or dry mouth may occur; therefore, further research is needed to strengthen the current evidence base.

Chamomile (*Matricaria chamomilla*), a widely used medicinal plant from the Asteraceae family, is recognized for its calming effects on stress, anxiety, and related psychological concerns [48]. Its key flavonoid, apigenin, exerts mild sedative effects primarily by modulating gamma-aminobutyric acid (GABA) receptors [48], as shown in Figure *4*. In addition, chamomile may help regulate the HPA axis and influence serotonin, dopamine, and noradrenaline pathways, together enhancing its anxiolytic effects and supporting stress relief [49]. Evidence synthesis further supports the use of chamomile in managing stress, anxiety, and generalized anxiety disorder (GAD) across diverse populations, including those in the MEA region [49,50].

In contrast to rhodiola, MEA-based interventional evidence for chamomile is more visible, particularly in studies involving aromatherapy and massage. These studies have reported reductions in stress and anxiety across diverse settings, including dental anxiety in children [51], and improvements in depression, anxiety, and stress levels in older adults [34]. Studies in maternal health have also reported that chamomile aromatherapy and massage can effectively lower anxiety during childbirth [52,53]. Beyond these settings, chamomile extract has been found to alleviate anxiety and depressive symptoms associated with premenstrual syndrome (PMS) in students [54], as well as procedural anxiety in burn survivors [55]. A cross-sectional study in patients with depression further reported that 46.9% used chamomile as a complementary therapy and expressed high satisfaction with its benefits [56].

Overall, both rhodiola and chamomile may provide substantial benefits for stress, fatigue, and mild mood-related concerns across diverse settings, supported by strong clinical evidence and expert perspectives. They may serve as safe and accessible complementary options for stress management when used responsibly. However, further MEA-based randomized trials with validated outcomes remain essential to strengthen the evidence base. A comprehensive summary of all relevant studies is provided in the Appendices.

Statement 4: Ashwagandha and panax ginseng are evidence-based adaptogenic herbs that support stress resilience

Agreement: Agree: 3; Strongly Agree: 1; Neutral: 1; Level of evidence: A

Ashwagandha (*Withania somnifera*), an herb from the Solanaceae family, is widely used to potentially enhance mental and physical resilience and promote overall well-being [37]. Its anti-stress benefits are primarily attributed to its adaptogenic activity, which helps downregulate the hypothalamic-pituitary-adrenal/sympathetic-adrenal-medullary (HPA/SAM) systems, thereby reducing cortisol and catecholamine levels [37]. Ashwagandha also enhances GABAergic and serotonergic signaling and provides antioxidant and anti-inflammatory effects, collectively supporting its anxiolytic and antidepressant properties [57], as shown in Figure *4*.

Consistent with its established adaptogenic profile, a substantial body of high-level evidence supports the clinical benefits of ashwagandha. Multiple systematic reviews and meta-analyses have consistently demonstrated its benefits in reducing stress and anxiety [58,59]. RCTs have also reported significantly lower perceived stress and reduced Hamilton Anxiety Rating Scale (HAM-A) scores, along with reductions in serum cortisol levels [33,60,61]. While further large-scale, high-quality trials are still needed, current evidence positions ashwagandha as a promising and generally safe intervention for the management of stress and anxiety symptoms.

Emerging clinical evidence from the MEA region indicates that ashwagandha may also serve as a safe and effective adjunct to selective serotonin reuptake inhibitors (SSRIs) in GAD, although further research is warranted [62]. Beyond stress-related outcomes, studies have described improvements in sleep quality, mood, and broader psychological well-being, particularly with longer treatment durations and good tolerability across formulations. Additional potential benefits have also been reported in relation to memory, focus, fatigue, and cognitive performance [63-67]. Overall, the evidence base supports ashwagandha as a promising adjunct for stress and anxiety management, with a favorable tolerability profile. The expert panel similarly endorsed its role in improving mental alertness and reducing stress, consistent with its established adaptogenic properties. The expert panel recommended a commonly used dosage of ~500 mg twice daily and advised cautious use in individuals with hyperthyroidism, liver dysfunction, or hormone-sensitive conditions and in those who are pregnant or breastfeeding. These precautions are consistent with authoritative safety summaries, which also note the potential for drug-supplement interactions, including interactions with antihypertensive (blood pressure) medications, and therefore support supervised or limited use in such populations [68]. The panel reaffirmed the importance of careful patient selection and medication review when incorporating ashwagandha into stress-support regimens.

Ginseng (*Panax ginseng*) is a widely used traditional medicinal herb whose major bioactive constituents, ginsenosides, exhibit neuroprotective, immunomodulatory, and nitric oxide-related effects. These mechanisms are considered relevant to pathways involved in mood regulation and stress adaptation [69]. Recent research has also highlighted its potential role in the prevention and management of depression and anxiety through multiple pharmacological pathways [70,71]. Proposed mechanisms underlying its antidepressant effects include modulation of the monoamine neurotransmitter system, regulation of HPA axis activity, and enhancement of neurotrophic factors such as brain-derived neurotrophic factor (BDNF), as shown in Figure *4* [70].

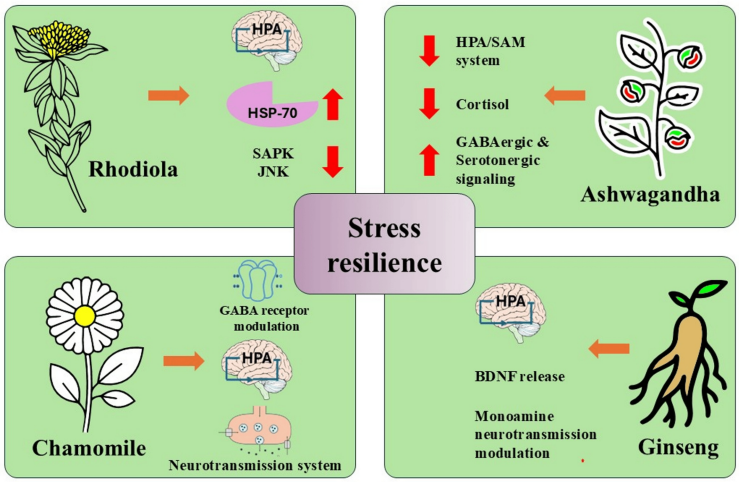


FIGURE 4: Potential mechanistic pathways through which rhodiola, ashwagandha, chamomile, and ginseng enhance stress resilience

The red upward arrow indicates an increase in activity, and the red downward arrow indicates a decrease in activity.

HPA: hypothalamic-pituitary-adrenal axis; SAM: sympathetic-adrenal-medullary system; HPA-SAM: hypothalamic-pituitary-adrenal/sympathetic-adrenal-medullary system; HSP70: heat shock protein 70; SAPK: stress-activated protein kinase; JNK: c-Jun N-terminal kinase; GABA: gamma-aminobutyric acid; BDNF: brain-derived neurotrophic factor.

Source: Author's own illustration based on [37-39,48,49,57,69,72].

This figure was created using Adobe Illustrator (Adobe Inc., San Jose, California).

Although MEA-specific clinical evidence on ginseng for stress- and depression-related outcomes remains limited, the broader global literature more consistently supports its stress-modulating potential. Available regional studies report mixed findings. One study showed reduced serum malondialdehyde (MDA), a biomarker of lipid peroxidation, together with increased eustress following ginseng use [72], whereas another RCT found no significant effect on anxiety or depression outcomes in patients attending addiction treatment clinics in Ahvaz [73]. Evidence from global studies, however, appears more encouraging. One RCT reported a significant decrease in perceived stress following ginseng supplementation [74], while another demonstrated reduced stress and tension, reflected by a lower composite stress index, possibly related to modulation of default mode network (DMN) functional connectivity, which is a key neural system involved in stress processing [75].

Heat-processed ginseng has also been associated with mitigation of stress-related cognitive effects through autonomic and metabolic pathways, including reductions in catecholamine levels and modulation of inflammatory responses, findings consistent with an adaptogenic role [76]. Overall, despite the limited and inconsistent evidence from the MEA region, the broader clinical literature suggests that ginseng may contribute to improvements in stress- and mood-related symptoms. However, more robust region-specific studies are needed to clarify its clinical relevance for MEA populations.

Expert perspectives were broadly aligned with these findings. In particular, different ginseng varieties, including American, Asian, and Siberian ginseng, were regarded as potent adaptogenic herbs that may enhance the body's ability to cope with both physical and emotional stress. The panel also highlighted their potential positive effects on cognitive function and broader physiological well-being. At the same time, the experts acknowledged that ongoing updates and diverse opinions within the European monograph reflect a lack of complete consensus regarding its clinical use, underscoring the need for clearer guidance from both scientific and regulatory bodies.

Section 3: Role of Herbals in Managing Sleep

Statement 5: Valerian root and lavender are effective in promoting sleep onset and quality.

Agreement: Agree: 3; Strongly Agree: 1; Neutral: 1; Level of evidence: A

Valerian root (*Valeriana officinalis*) is a well-known therapeutic herb widely used to mitigate sleep- and anxiety-related problems, largely through its active constituents valerenic acid and valerenol (Figure *5*) [77]. These compounds positively modulate GABA-A receptors through allosteric binding, thereby promoting relaxation [78]. Additionally, preliminary evidence suggests that valerian may partly stimulate 5-hydroxytryptamine 2A (5-HT2A) receptors, aiding melatonin release and further contributing to sleep regulation [77,79]. Systematic reviews suggest that valerian may improve insomnia, with some studies reporting reduced sleep latency [80] and better subjective sleep outcomes [81], including improvements in Pittsburgh Sleep Quality Index (PSQI) scores, sleep quality, sleep duration, and non-rapid eye movement (NREM) stage 3 sleep [82]. Another systematic review conducted across the Iranian region suggested that valerian may represent a safe therapeutic approach for managing sleep disorders in postmenopausal women [83]. MEA-based clinical studies further indicate that valerian may improve sleep quality and reduce insomnia symptoms in various female populations, including menopausal and postmenopausal women [84,85]. A cross-sectional study from Jordan showed that community pharmacists commonly recommended valerian-based herbal products for insomnia management, making it the second most frequently supplied option after conventional pharmacological treatments [86].

The expert panel described valerian as a mild sedative that enhances GABA activity, supports sleep quality, helps manage insomnia, and reduces anxiety while providing an overall calming effect. The panel emphasized the importance of using standardized preparations aligned with the European Union herbal monograph, which recommends an adult dose of around 300-600 mg, typically taken before bedtime, while also advising against use in children under 12 years due to insufficient safety data [87]. Overall, clinical evidence and expert perspectives collectively support valerian as a generally well-tolerated option that may improve subjective sleep quality and related symptoms.

Lavender (*Lavandula angustifolia*) is a widely used medicinal plant that may exert sleep-promoting and relaxation-enhancing effects on the central nervous system [88]. Its benefits are largely attributed to key active components, including linalool, linalyl acetate, and β-myrcene. Lavender may promote sleep by activating GABAergic neurons in the central amygdala through the olfactory pathway and by increasing levels of GABA, serotonin, glutamate, and melatonin, thereby supporting sleep regulation through multiple mechanisms (Figure *5*) [88-91]. Multiple clinical investigations conducted across the MEA region consistently show that lavender therapy is associated with significant improvements in sleep quality across a wide range of populations. Research involving postmenopausal women further indicates that lavender may enhance overall sleep quality [92,93]. Lavender-based preparations, such as creams and aromatherapy, have also shown significant value in pregnant and postpartum women, with studies reporting notable reductions in sleep-related discomfort, fatigue, and overall global sleep quality scores, underscoring its supportive role in maternal well-being [94-96].

Benefits have also been reported among older adults living in nursing care environments, where lavender interventions have led to measurable improvements in sleep latency, sleep interruptions, and daily functioning [97-99]. Furthermore, studies among students experiencing insomnia have highlighted the effectiveness of lavender oil in alleviating sleeplessness and fatigue-related symptoms [100]. Given lavender's favorable safety profile, the expert panel noted that its practical value may also extend to pediatric care. When used as a locally applied preparation, such as a topical oil, typically after the age of one year, it may provide calming effects and may represent a preferred, natural, and holistic option for managing sleep disturbances and mild anxiety in infants and young children. Taken together with broader clinical evidence, these insights indicate that lavender-based therapies represent a gentle, accessible, and nonpharmacological strategy for promoting better sleep and overall well-being across diverse demographic groups within the MEA region.

Statement 6: Passionflower and lemon balm improve sleep onset and quality in populations across the Middle East and Africa.

Agreement: Agree: 4; Disagree: 1; Level of evidence: A

Passionflower (*Passiflora incarnata*) is a traditional sedative herb that has long been used worldwide to alleviate insomnia symptoms and anxiety. Despite its widespread use, scientific evidence validating its active constituents and sleep-related mechanisms remains limited [101]. As illustrated in Figure *5*, the speculated mechanism by which passionflower exerts its sedative and anxiolytic effects involves modulation of the GABAergic system, potentially through inhibition of GABA reuptake and binding to both GABA-A and GABA-B receptors, thereby reducing neuronal excitability [102].

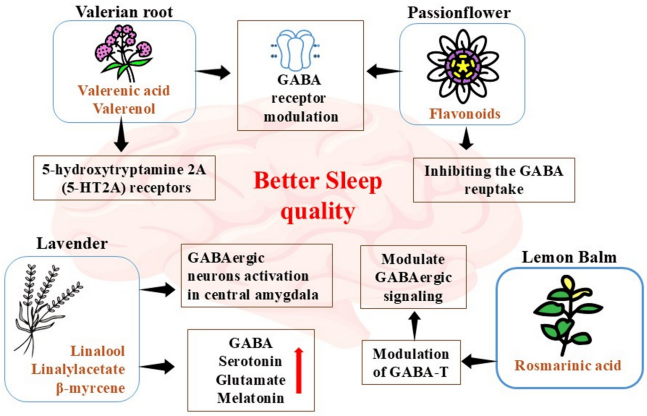


FIGURE 5: Potential mechanisms by which valerian, lavender, passionflower, and lemon balm support improved sleep quality

The red upward arrow indicates an increase in activity.

GABA: gamma-aminobutyric acid; GABA-T: gamma-aminobutyric acid transaminase; 5-HT2A: 5-hydroxytryptamine 2A receptor.

Source: Author's own illustration based on [77,79,88-91,101,102].

Figure created using Adobe InDesign and Illustrator (Adobe Inc., San Jose, California).

Global evidence also indicates that low-dose passionflower tea may offer short-term subjective sleep benefits in adults with mild sleep fluctuations [101]. A double-blind RCT demonstrated improvements in objective sleep parameters measured via polysomnography in patients with insomnia disorder [103]. Aerial extracts of passionflower have also shown improvements in stress-related insomnia with a favorable safety profile [104].

The expert panel's perspectives were consistent with these findings and corroborated the role of passionflower in improving sleep quality, helping to ease restlessness and support more consolidated sleep. Overall, while global studies suggest that passionflower may provide both subjective and objective sleep benefits, evidence from the MEA region is comparatively sparse. This highlights the need for more well-designed regional trials to confirm efficacy, establish optimal dosing, and strengthen safety data in diverse MEA populations.

Lemon balm (*Melissa officinalis* L.) is a Mediterranean herb widely used in herbal practice, with growing interest in its calming properties and potential benefits for sleep disturbances [105]. Its sleep-supporting effects are thought to be linked to rosmarinic acid, which may influence GABAergic signaling by modulating GABA transaminase (GABA-T), an enzyme involved in the breakdown of GABA, a key inhibitory neurotransmitter that regulates relaxation and sleep [106]. By supporting GABA balance, lemon balm may promote relaxation and improve sleep quality, as illustrated in Figure *5*. Clinical evidence supporting the use of lemon balm for sleep outcomes in the MEA region is emerging, with several studies suggesting benefits across different life stages and settings. A systematic review by Ghazizadeh et al. (2021) summarized regional trials and reported that lemon balm may support mental well-being in adolescent girls with PMS, including improvements in associated complaints such as sleep disturbances, psychosomatic symptoms, and anxiety, with a favorable tolerability profile [107,108].

Observational data from Turkey further indicate that lemon balm is commonly used in real-world settings, with approximately 28% of mothers reporting its use to help children with calming and sleep-related problems [109]. Complementary approaches have also been explored in maternal settings, with one RCT reporting that inhalation aromatherapy using lemon balm essential oil improved sleep quality in mothers of preterm infants, supporting its potential role as an adjunctive supportive strategy [110].

Overall, the available clinical and observational findings consistently suggest that lemon balm may offer a safe, accessible, and supportive option for improving sleep disturbances across diverse populations. However, further robust regional trials are needed to confirm efficacy and standardize its use. The expert panel concurred with this evidence and highlighted lemon balm's role in easing nervous tension, further

reinforcing its usefulness as a calming, sleep-supportive herbal option.

Section 4: Role of Herbals in Managing Immunity

Statement 7: Ashwagandha and Panax ginseng are evidence-based adaptogenic herbs that enhance immune function.

Agreement: Agree: 2; Strongly Agree: 2; Neutral: 1; Level of evidence: A

Beyond its role in stress relief, ashwagandha (*Withania somnifera*) also exhibits immunomodulatory activity, largely attributed to its withanolide content, which influences cytokine production and promotes immune-cell proliferation [111]. Ashwagandha has been reported to enhance immune responsiveness through modulation of cytokine activity, increased T-cell and B-cell function, and improved phagocytic capacity [112]. Its antioxidant effects have also been linked to the presence of polyphenols, flavonoids, and alkaloids, as illustrated in Figure *6* [112].

A systematic review reported immunomodulatory and antiviral effects of ashwagandha, particularly improvements in innate immune responses among individuals with low immune-cell counts [113]. In an RCT, ashwagandha significantly increased cytokine levels (IL-4 and IFN-γ), immunoglobulins (IgA, IgM, IgG), and T-cell, B-cell, and natural killer (NK) cell subsets in healthy adults, indicating strengthened innate and adaptive immunity and a potential reduction in infection risk [114]. A prophylactic study evaluating protection against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection also reported immunomodulatory effects comparable to those of hydroxychloroquine among healthcare workers [115]. Overall, ashwagandha appears to support both innate and adaptive immune responses and may help reduce the burden of upper respiratory tract infections (URTIs), making it a promising option for promoting immune resilience, particularly in individuals with low baseline immune function.

Ginseng (*Panax ginseng*) also exhibits immunomodulatory activity, primarily attributed to ginsenosides. These compounds enhance innate immunity through macrophage activation, increased NK-cell activity, and cytokine stimulation, while also modulating adaptive immunity by influencing antibody levels, promoting T-cell proliferation, and regulating cytokine responses, thereby supporting broad B-cell and T-cell functions (Figure *6*) [17,116]. Global evidence reflects these mechanisms. A systematic review summarizing trials on ginseng for common cold prevention in healthy adults showed significantly fewer influenza or cold cases, accompanied by increased antibody titers and NK-cell activity, suggesting that ginseng preparations may strengthen immune responses and help protect against respiratory infections [117,118]. Additional reviews and clinical trials have also shown a reduced risk of acute respiratory illness (ARI), as well as shorter and less severe symptoms [119,120]. Within the MEA region, direct clinical evidence remains limited. However, available global data suggest that modified ginseng extract may reduce ARI incidence in healthy individuals [121], while a clinical trial in individuals with weakened immunity showed significant improvements in immune-related health scores and elevated IgA levels following ginseng supplementation [122]. Other studies have reported increases in T cells, B cells, and white blood cells among healthy adults [123], as well as immune enhancement associated with a ginseng-derived polysaccharide [124]. Taken together, these findings suggest that ginseng may provide preventive benefits during periods of high infectious exposure, with immunomodulatory effects consistent with lower ARI risk and reduced symptom burden. Although MEA-specific evidence is scarce, the available findings support its potential regional relevance.

Collectively, ashwagandha and ginseng show consistent evidence of strengthening both innate and adaptive immunity, thereby contributing to reduced respiratory illness burden and improved immune resilience. The expert panel similarly noted that ginseng acts as a supportive adaptogen with antioxidant and anti-inflammatory effects that help maintain immune balance.

Statement 8: Echinacea and Elderberry play an important role in regulating the immune system.

Agreement: Agree: 3; Strongly Agree: 1; Neutral: 1; Level of evidence: A

Echinacea, which belongs to the Asteraceae family, includes the principal species *E. purpurea*, *E. angustifolia*, and *E. pallida*, all of which have indicated protective effects against respiratory infections and inflammation [125]. It is recognized primarily as an immunostimulant, acting through increased cytokine production, activation of NK cells and macrophages, and modulation of JNK and nuclear factor kappa B (NF-κB) pathways, contributing to enhanced innate and adaptive immune responses (Figure *6*) [126].

Evidence from systematic reviews and meta-analyses indicates that echinacea may serve as a useful adjunctive therapy for the prevention of respiratory tract infections (RTIs) in children [127], aligning with other studies highlighting its potential to reduce RTI incidence [128,129]. Short-term safety appears generally favorable, although stronger and more standardized datasets are still needed [130]. Another meta-analysis of six clinical studies showed a reduced risk of recurrent respiratory infections and related complications, underscoring echinacea's immunomodulatory and anti-inflammatory actions [36]. Within the MEA region, evidence is limited; however, global studies support the efficacy of echinacea. RCTs have

reported significant reductions in common cold symptom scores and improvements in immune cell levels (monocytes, neutrophils, and NK cells) [131,132]. Another RCT demonstrated faster recovery with echinacea treatment compared with placebo [133]. However, other studies found no significant improvement in the frequency or severity of upper respiratory tract symptoms [134,135]. Overall, the available evidence consistently supports echinacea's role in strengthening immune function and reducing respiratory infection burden through innate immune modulation, while also highlighting the need for more targeted research in MEA populations.

Elderberry (*Sambucus nigra*), a member of the Adoxaceae family, has long been used globally for supporting immune health and managing common colds, influenza, and other URTIs [136]. As shown in Figure 6, its immunomodulatory activity is primarily attributed to cyanidin-3-glucoside, which may enhance IL-6, IL-8, and TNF activity [137]. Its polysaccharide components may also contribute to dendritic-cell maturation and subsequent T-cell activation, alongside broader cytokine modulation that is important for effective immune responses [138]. A systematic review incorporating studies from the MEA region concluded that elderberry may reduce the duration and severity of colds as well as shorten influenza episodes and lower infection risk [139]. These findings are reinforced by a meta-analysis identifying elderberry as a potentially safe alternative therapy capable of significantly reducing symptoms associated with URTIs [140]. Within the MEA region, an RCT reported marked symptom improvement during an influenza outbreak, with 93.3% of participants treated with elderberry extract showing significant recovery and 90% achieving faster resolution compared with placebo [141]. Additional findings further suggested that elderberry may represent an efficient, safe, and cost-effective option for influenza management [142]. Global trials also support these observations. For example, a study among air travelers reported a significant reduction in the duration and severity of cold symptoms among those who consumed standardized elderberry extract [143]. Taken together, these botanicals indicate potential in supporting respiratory health, especially in high-exposure groups such as children, older adults, and frequent travelers. Although they differ in their active compounds and act at different points within the immune response, they may provide a complementary benefit. Echinacea appears to be more closely associated with early activation of innate immune cells [125,126], whereas elderberry shows clearer benefits when used as a short-course intervention at the onset of symptoms to reduce illness burden [139,140]. These botanicals should therefore not be viewed simply as broad "immune boosters" but rather as targeted supportive agents that may offer the greatest benefit when used at the right time and in appropriate individuals.

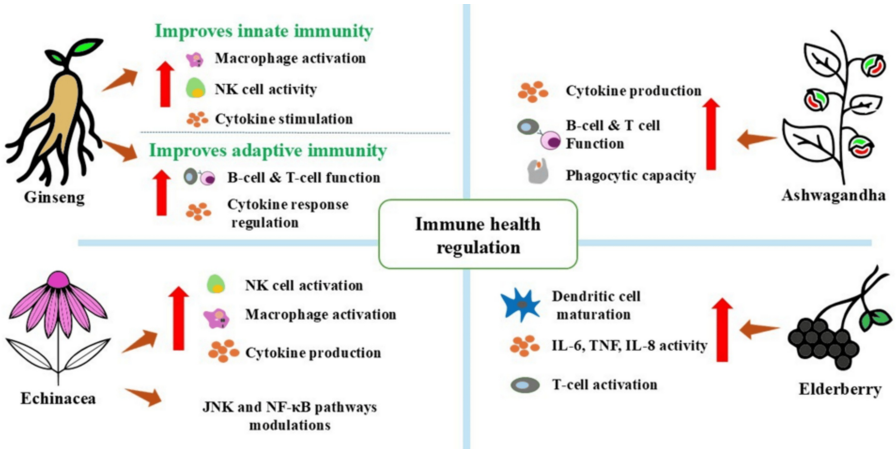


FIGURE 6: Overview of immune-supportive mechanisms activated by ginseng, ashwagandha, echinacea, and elderberry

The red upward arrow indicates an increase in activity.

NK: natural killer cells; IL-6: interleukin-6; TNF: tumor necrosis factor; IL-8: interleukin-8; JNK: c-Jun N-terminal kinase; NF-κB: nuclear factor kappa-light-chain-enhancer of activated B cells.

Source: Author's own illustration based on [17,111,112,116,126,136,137].

Figure generated using Adobe Illustrator (Adobe Inc., San Jose, California).

The expert panel emphasized that although both echinacea and elderberry are supported by strong clinical and real-world evidence, challenges such as inconsistent product quality, lack of standardization, limited pediatric guidance, and regulatory gaps may affect their broader adoption and safe use. The panel highlighted the need for robust, tailored clinical trials, particularly involving children and pregnant women, while also advocating for globally aligned standards so that safety and effectiveness can be evaluated consistently worldwide. They further noted that future progress will depend on evidence-based products,

stronger regulatory oversight, and greater focus on quality-controlled herbal preparations.

Statement 9: Combining herbal ingredients with essential micronutrients offers a holistic approach to enhance wellness.

Agreement: Agree: 1; Strongly Agree: 2; Neutral: 1; Level of evidence: A

Integrating herbal ingredients with essential micronutrients offers a comprehensive approach to improving overall wellness by targeting multiple biological pathways involved in stress resilience, sleep quality, and immune function [144]. Micronutrients play critical roles in energy metabolism, neuroendocrine balance, immune competence, and antioxidant defense, acting as essential cofactors in numerous physiological processes [145]. Alongside these nutritional components, herbal adaptogens and calming botanicals such as ashwagandha, rhodiola, and many others may provide complementary support by regulating the HPA axis, GABAergic activity, and associated neurochemical signaling pathways, thereby promoting stress regulation, sleep quality, and immune function [38,57]. Reflecting real-world consumer use, emerging RCTs and multi-ingredient formulation studies suggest that combinations of botanicals and micronutrients, as evaluated in these studies, may offer measurable benefits across stress, sleep, and immune outcomes.

Daily supplementation with ginseng formulated with vitamins and minerals has been associated with improved self-perceived health ratings, including stress-related measures, in adults experiencing fatigue [146]. In the context of immune health, a double-blind randomized trial evaluating a combination of echinacea, zinc, and vitamin C reported reductions in the duration and severity of URTI symptoms, supporting the potential role of such combinations in reducing inappropriate antibiotic use and, indirectly, antibiotic resistance [147].

Building on this evidence, ginseng-based micronutrient combinations have also indicated positive effects on broader well-being outcomes. In a large double-blind trial in individuals experiencing high levels of physical and mental stress, a formulation containing multivitamins, minerals, and ginseng produced greater improvements in quality-of-life measures than multivitamins alone [148]. A summary of the potential herbal-micronutrient combinations is provided in the supplementary material (Appendices).

Despite these promising findings, opinions among the expert panel varied regarding the strength of evidence supporting combined herbal-micronutrient formulations for wellness. Several members acknowledged the potential synergistic effects of such combinations, highlighting possible benefits in stress regulation, sleep quality, immune resilience, and overall well-being through complementary biochemical pathways. At the same time, other panel members emphasized important practical considerations that balance this enthusiasm, noting that combining herbal ingredients with other ingredients without adequate guidance may introduce safety challenges. Inappropriate dosing, timing, or ingredient pairings may reduce effectiveness or contribute to diminished tolerance over time. Moreover, authoritative reports indicate that many claims of synergy are generally derived from animal studies or cellular assays or are based on other indirect means, limiting causal interpretation and underscoring the need for larger, well-designed clinical studies [149]. The expert panel also observed that many consumers lack clear direction on how to use multi-ingredient products appropriately, reinforcing the need for better education around safe usage practices. In line with these safety-focused perspectives, the panel further clarified that certain targeted combinations are generally regarded as safe when used at appropriate doses and that hesitation regarding such products often reflects consumer preference rather than clinical concern. Overall, these viewpoints highlight the need for well-researched formulations, clear dosing guidance, and the responsible integration of herbal supplements into everyday wellness routines.

Statement 10: Herbal ingredients including rhodiola, chamomile, ashwagandha, ginseng, valerian, lavender, passionflower, lemon balm, echinacea, and elderberry can be considered safe when consumed in permissible dosage forms

Agreement: Agree: 3; Strongly Agree: 1; Neutral: 1; Level of evidence: A

The safety profiles of the herbal ingredients, including rhodiola, chamomile, ashwagandha, ginseng, valerian, lavender, passionflower, lemon balm, echinacea, and elderberry, have been evaluated across multiple clinical trials and systematic reviews, with most reporting good tolerability when these herbs are consumed within recommended or clinically studied dosage ranges. Chamomile has been associated primarily with mild gastrointestinal or sedative symptoms, and no serious adverse events were reported in the included trials [50]. Safety analyses of echinacea likewise indicate no apparent short-term risk, although interpretation is constrained by study heterogeneity and selective reporting, making conclusions regarding long-term safety less certain [130].

Ashwagandha has shown a favorable safety profile, with no significant adverse events or laboratory abnormalities reported in a placebo-controlled safety study, and it was also well tolerated in an RCT involving patients with GAD [62,150]. The experts recommended a commonly used dosage of around 500 mg twice daily while emphasizing caution in vulnerable populations, including those with conditions such as

hyperthyroidism or liver-related concerns and those who are breastfeeding or pregnant. They also highlighted that concomitant use with antihypertensive medications should be undertaken under medical supervision and that discontinuation should be considered if adverse effects or interactions are suspected. Furthermore, a comprehensive assessment of the cumulative vitamin and mineral content in combination formulations was recommended to prevent intake above tolerable upper limits.

Elderberry has been evaluated in controlled trials, and meta-analytic evidence for URTI symptom relief, and a placebo-controlled influenza study described it as safe and well tolerated [140,142]. Rhodiola extract has likewise shown no serious adverse events, with reported side effects being mild in intensity [47]. The expert panel further advised that pregnant or breastfeeding women should use rhodiola cautiously because of limited safety data and that individuals with diabetes may require monitoring because of its potential effects on blood glucose. The panel recommended oral use of rhodiola for 6-12 weeks, followed by a short break, to minimize mild adverse effects such as dizziness or dry mouth.

A systematic review of 44 ginseng studies reported only temporary and mild adverse events, most commonly insomnia, hot flashes, and dyspepsia, reinforcing its overall tolerability when consumed within studied dosage ranges [151]. According to European Union (EU) monograph recommendations, an adult dosage of 300-600 mg taken before bedtime is considered appropriate for valerian, whereas use in children under 12 years is not recommended because of insufficient safety data [87].

Furthermore, passionflower is also considered safe, with no significant side effects reported [101,102,104]. Although the available evidence supports the overall safety of these herbal ingredients, careful consideration remains essential for vulnerable populations, individuals taking concurrent medications, and those with underlying health conditions. Potential herb-drug interactions, comorbidities, and interindividual differences in physiological response may all influence tolerability. The expert panel further emphasized the importance of clear dosing guidance, appropriate monitoring, and responsible use, particularly when herbal ingredients are combined with other botanicals or micronutrients in wellness or clinical settings.

Statement 11: Standardized products of herbal ingredients with defined dosage limits and warnings are essential to ensure responsible use and avoid potential harm.

Agreement: Agree: 1; Strongly Agree: 3; Neutral: 1; Level of evidence: A

The expansion of herbal markets across several countries can create safety challenges when products enter the market without consistent regulatory review of quality, toxicity, or post-marketing surveillance [152]. Even though many consumers perceive herbal products as natural and therefore preferable to conventional medicines, responsible use ultimately depends on whether their benefits and risks have been demonstrated using well-characterized, standardized preparations [153]. Standardization is essential because phytochemical composition can vary substantially depending on factors such as cultivation methods, geographical origin, and harvesting processes. This variability poses challenges for maintaining product quality and may ultimately affect the safety, potency, and clinical reproducibility of herbal preparations [154]. Standardization and quality assurance can also minimize potential risks arising from contamination, mislabeling, and intentional adulteration of herbal products, which may contribute to toxicity and unexpected herb-drug interactions [152,154]. Standardized herbal products with defined dosage limits are critical because safety is more reliably established within clinically studied dose ranges, whereas unregulated intake may increase the risk of adverse events. For example, a standardized lavender oil preparation administered at a fixed dose has shown therapeutic potential for anxiety and related sleep complaints with generally favorable tolerability, although some patients discontinued treatment because of adverse events [155].

Similarly, a network meta-analysis evaluating standardized lavender oil products across trials supported their clinical utility while also highlighting the occurrence of adverse events, including gastrointestinal complaints [156]. These findings not only indicate that standardized, fixed-dose herbal preparations can produce reproducible therapeutic effects but also reveal that even standardized products may carry measurable risks. Together, these findings underscore the importance of dose definition, product standardization, and transparent safety information for responsible herbal use and informed consumer decision-making.

Additional evidence from a standardized rhodiola extract (SHR-5) reported no serious side effects at studied doses [43], while controlled safety studies of ashwagandha extract (KSM-66) have indicated good tolerability when standardized extracts are used within defined dose ranges [65]. The expert panel emphasized that delivering herbal products, especially ashwagandha, in controlled and standardized dosage forms is critical to prevent misuse and ensure safety. The panel highlighted that some users may experience early benefits and then escalate doses unsafely in pursuit of faster results. Therefore, clear labeling, defined dose limits, and convenient fixed-dose formulations, such as tablets and ampoules, were recommended to discourage overuse. Pharmaceutical-grade products were also viewed as improving adherence to recommended doses, whereas loose herbal preparations, such as teas, may be consumed casually, which increases the risk of

unintended overdose.

Collectively, these findings, together with expert perspectives, support the broader view that standardized formulations with defined dose limits and clear warnings are essential to ensure consistent results and protect users, particularly vulnerable individuals or those at risk of herb-drug interactions (Table *1*). This also highlights the need for alignment with established regulatory and pharmacovigilance standards to minimize avoidable harm and promote the responsible use of herbal products.

S. no.	Consensus	Agreement	Key supporting evidence [reference citation]	Level of evidence
Herbals in Managing Stress, Sleep and Immune Health in the Middle East and Africa				
1	Stress, sleep, and immune health are significant public health concerns in the Middle East and Africa.	Agree: 2; Strongly agree: 3	2 SR and MA of observational studies [5,26]; 3 CSS/secondary analysis of CSS [23-25]	C
2	Herbal ingredients are traditionally recognized in the Middle East and Africa region for managing stress, sleep, and immune health.	Agree: 2; Strongly agree: 3	1 SR and MA of RCTs [33]; 1 MA of RCTs [36]; 2 RCTs [34,35]	A
Role of Herbals in Managing Stress				
3	Rhodiola and Chamomile are known to help modulate stress in the Middle East and Africa.	Agree: 3 Strongly agree: 1 Disagree: 1	4 SR [39-41,49]; 1 SR and MA of RCTs [50]; 8 RCTs [34,43,44,51-55]; 4 Clinical trials [42,45-47]; 1 CSS [56]	A
4	Ashwagandha and Panax ginseng are evidence-based adaptogenic herbs that support stress resilience.	Agree: 3; Strongly agree: 1; Neutral: 1	1 SR [59]; 4 SR and MA of RCTs [33,58,60,61]; 12 RCTs [57,62-67,72-76]	A
Role of Herbals in Managing Sleep				
5	Valerian root and Lavender are effective in promoting sleep onset and quality.	Agree: 3; Strongly agree: 1; Neutral: 1	3 SR/SR and MA [78,80,83]; 5 SR and MA or MA of RCTs [81,82,96,93,99]; 8 RCTs [84,85,92,94,95,97,98,100]; 1 CSS [86]	A
6	Passionflower and Lemon Balm improve sleep onset and quality in populations across the Middle East and Africa.	Agree: 4; Disagree: 1	1 SR and MA of RCTs [107]; 3 RCTs [103,104,110]; 1 Clinical trial [101]; 1 CSS [109]	A
Role of Herbals in Managing Immunity				
7	Ashwagandha and Panax ginseng are evidence-based adaptogenic herbs that enhance immune function.	Agree: 2; Strongly agree: 2; Neutral: 1	5 SR/SR and MA [59,112,113,118,119]; 7 RCTs [114,115,117,120,122-124]	A
8	Echinacea and Elderberry play an important role in regulating the immune system.	Agree: 3; Strongly agree: 1; Neutral: 1	1 SR of RCTs [127]; 5 SR and MA or MA of RCTs [36,128-130,140]; 7 RCTs [131-135,142,143]; 1 Clinical trial [141]	A
9	Combining herbal ingredients with essential micronutrients offers a holistic approach to enhance wellness.	Agree: 1; Strongly agree: 2; Neutral: 2	2 RCTs [147,148]; 1 Clinical trial [146]	A
10	Herbal ingredients including rhodiola, chamomile, ashwagandha, ginseng, valerian, lavender, passionflower, lemon balm, echinacea, and elderberry can be considered safe when consumed in permissible dosage forms.	Agree: 3; Strongly agree: 1; Neutral: 1	2 SR of RCTs [102,151]; 3 SR and MA or MA of RCTs [50,130,140]; 4 RCTs [62,104,142,150]; 2 Clinical trials [47,101]	A
11	Standardized products of herbal ingredients with defined dosage limits and warnings are essential to ensure responsible use and avoid potential harm.	Agree: 1; Strongly agree: 3; Neutral: 1	1 Network meta-analysis of RCTs [156]; 1 RCT [65]; 1 post-hoc analysis of RCTs [155]; 1 Clinical trial [43]	A

TABLE 1: Expert consensus statements on herbal solutions for managing stress, sleep, and immunity, with corresponding agreement levels, supporting clinical evidence, and assigned levels of evidence

CSS: cross-sectional study, RCT: randomized controlled trial, SR: systematic review, MA: meta-analysis.

Discussion

This study synthesizes regional and global evidence, together with expert consensus, to address the growing burden of stress, sleep disturbances, and immune-related concerns across the Middle East and Africa (MEA). The findings confirm that these domains represent interrelated and increasingly important wellness priorities in the region, with meaningful implications for quality of life, healthcare utilization, and preventive health strategies [3,5,25,29]. At the same time, the longstanding cultural acceptance of herbal medicine in MEA creates a unique opportunity to integrate traditional practices with contemporary evidence-based care. Within this context, the present consensus provides a structured framework for interpreting available evidence and translating it into practical recommendations for the safe and responsible use of botanicals in modern healthcare settings.

A key contribution of this study is its distinction between botanicals supported primarily by MEA-based evidence and those for which evidence is derived largely from global studies. Chamomile, valerian, lavender, and lemon balm appear to have comparatively stronger regional support, particularly in relation to sleep, stress relief, and respiratory or immune well-being [34,51-56,84-86,92,94,95,97,98,100,109,110]. By contrast, ashwagandha, rhodiola, ginseng, passionflower, echinacea, and elderberry are supported more strongly by international evidence, with relatively limited direct clinical evaluation in MEA populations [42-47,57,63-67,74-76,76,101,114,115,117,120,120,122-124,131-135,142,143]. This pattern is important because it highlights both the translational potential of these herbal interventions and the limitations of extrapolating findings from non-MEA populations, especially for non-native botanicals whose use, formulation, or biological response may differ by setting, culture, and population characteristics.

The findings also point to a broader structural issue: the relative scarcity of robust MEA-generated evidence reflects persistent limitations within the regional research ecosystem. Despite the region's rich ethnobotanical heritage and extensive reliance on traditional medicine, there remain major constraints in clinical research capacity, methodological rigor, funding, and regulatory support [32,157]. These gaps are especially relevant in parts of Africa, where indigenous medicinal knowledge is extensive but investment in high-quality clinical evaluation remains limited [157]. As a result, the evidence base is uneven, and clinicians are often required to rely on fragmented local experience or extrapolated international data when advising patients on herbal use. This reinforces the need for stronger collaboration between conventional healthcare practitioners, academic researchers, and traditional medicine stakeholders to generate more contextually relevant evidence and support integrated, patient-centered care pathways.

Another important finding is that the use of herbal ingredients in MEA is not constrained only by evidence gaps but also by implementation challenges. The translation of herbal medicine into routine care is complicated by inconsistent practitioner training, limited professional oversight, gaps in evidence-based counseling, and variable regulatory enforcement [158,159]. These barriers are particularly significant in community-based settings, where advice may be inconsistent and self-directed use is common. The present study therefore supports not only further efficacy research but also stronger systems for clinician and consumer education, improved pharmacovigilance, and more reliable real-world data collection. Such measures are essential if herbal products are to be integrated responsibly into wellness-oriented and preventive care models in the region.

Standardization emerged as one of the central themes of this study and arguably one of the most urgent priorities for progress in the field. Variability in cultivation conditions, plant chemotypes, extraction methods, formulation types, and dosing regimens can meaningfully alter phytochemical composition and, consequently, clinical outcomes [154,160]. This challenge is particularly relevant for botanicals such as ginseng, where differences in ginsenoside profiles and processing methods may contribute to heterogeneous findings across studies [161,162]. The panel's emphasis on standardized preparations, defined dose ranges, and clear product warnings is therefore highly justified. Without greater consistency in product quality and composition, it is difficult to compare studies, establish reproducible therapeutic effects, or give reliable clinical guidance [154,160]. Standardization is not only a methodological requirement but also a safety imperative, particularly in markets where regulatory oversight and post-marketing surveillance remain variable [152,159].

The panel also highlighted the importance of population-specific relevance, particularly in the sleep domain. Across the included evidence, the strongest MEA-based data for sleep-related botanicals were observed in women's health contexts, including premenstrual syndrome, menopause, pregnancy, and the postpartum

period [163]. This is an important regional insight because it suggests that some herbal strategies may have especially high translational value in subgroups that experience a disproportionate burden of sleep disturbance. Rather than treating herbal medicine as a uniform category, future work should therefore prioritize more targeted evaluation in clinically relevant populations, including women, older adults, children, and individuals with comorbidities or concurrent medication use. Such stratification would improve both scientific precision and practical applicability.

The panel also recognized growing interest in combining herbal ingredients with essential micronutrients as part of a broader wellness strategy. Emerging evidence suggests that such combinations may offer complementary benefits across stress, sleep, and immune outcomes by targeting multiple biological pathways simultaneously [144,145]. Clinical studies of combined formulations, including ginseng with vitamins and minerals and echinacea with zinc and vitamins C and D, have reported improvements in fatigue-related perceptions, respiratory outcomes, and broader well-being measures [146,147]. However, this remains an area where enthusiasm should be balanced with caution. The current literature on herbal-micronutrient combinations is still limited by small and heterogeneous studies, incomplete safety reporting, unclear interaction profiles, and inconsistent standardization of formulations [164,165]. Concurrent use of herbal products and micronutrient supplements may increase the risk of clinically relevant interactions. Some herbal ingredients can alter the absorption, distribution, metabolism, or elimination of vitamins and minerals, while multi-ingredient regimens may produce additive pharmacological effects or reduce tolerability [12,164]. The simultaneous use of several supplements may increase cumulative micronutrient exposure, potentially exceeding recommended upper intake levels, particularly when products contain overlapping ingredients. These risks may be greater in individuals with comorbidities and vulnerable populations; therefore, supplement histories, contraindications, total nutrient intake, and potential herb-drug interactions should be assessed before combined use [149,152,164]. These limitations are particularly relevant in MEA settings, where self-supplementation may occur without adequate professional guidance and where evidence-based counseling remains inconsistent [159,166]. Accordingly, the consensus supports the use of such combinations only when formulations are well characterized, doses are clearly defined, and their use is embedded within appropriate clinical or pharmacist-led supervision [159].

Taken together, the findings of this study support a measured and evidence-informed integration of herbal interventions into wellness care across MEA. The panel does not position these botanicals as substitutes for conventional treatment but rather as supportive options that may be appropriate for selected stress-, sleep-, and immune-related needs when used within standardized, clinically studied ranges and with due consideration of safety, formulation quality, and population-specific factors. To advance this field, priority actions should include the conduct of high-quality MEA-specific randomized trials using standardized extracts, the establishment of real-world data systems, improved adverse-event reporting, stronger clinician and consumer education, and alignment with internationally recognized pharmacovigilance and regulatory standards. Such steps are essential for moving from traditional acceptance and market growth toward responsible, evidence-based implementation.

Strengths and limitations

A major strength of this consensus is the multidisciplinary and international composition of the expert panel, which enabled interpretation of the evidence through clinical, pharmacovigilance, wellness, nutrition, and pediatric perspectives relevant to MEA settings. While the small panel size may limit the broader representativeness of the consensus, its multidisciplinary composition ensured the inclusion of diverse and relevant expertise. In addition, the integration of region-specific evidence with broader global literature allowed the panel to provide practical guidance despite variability in the underlying evidence base. The consensus approach also helped identify areas of agreement that are likely to be clinically meaningful for regional practice. However, several limitations should be acknowledged. First, the number of robust MEA-specific randomized controlled trials remains limited, restricting the ability to make fully region-specific inferences for several botanicals. Second, the evidence base is heterogeneous in terms of study populations, formulations, dosing regimens, and outcome measures, which limits direct comparability across studies. Third, long-term safety data, especially for vulnerable populations and for herbal-micronutrient combinations, remain insufficient. These limitations underscore the need for more rigorous, standardized, and regionally relevant research to strengthen future recommendations.

Conclusions

The growing burden of stress, sleep disturbances, and immune-related challenges across the MEA region highlights the need for supportive, accessible, and culturally acceptable wellness strategies. In a region where trust in traditional and plant-based medicine remains strong, evidence-based integration of herbal approaches represents a valuable opportunity to address these interconnected health concerns. The present consensus, supported by regional and global evidence, suggests that selected botanicals, namely chamomile, valerian, lavender, lemon balm, passionflower, echinacea, elderberry, ashwagandha, rhodiola, and ginseng, can provide complementary benefits for stress management, sleep quality, and immune function. When used alone or in appropriately formulated combinations with targeted micronutrients, these interventions demonstrate meaningful translational potential in real-world MEA settings. However, these botanicals should be viewed as supportive rather than substitutive therapies. Their effective and safe use requires

standardized formulations, clearly defined dosing ranges, appropriate safety monitoring, and consideration of individual patient characteristics. Strengthening product quality, improving regulatory oversight, and enhancing clinician and consumer awareness will be essential to ensure responsible use. Looking forward, advancing the role of herbal and herbal-micronutrient strategies in MEA will depend on the generation of high-quality region-specific evidence, better standardization of products and practices, and alignment with global safety and pharmacovigilance frameworks. Collectively, these efforts will support the integration of culturally relevant, evidence-based botanical interventions into modern healthcare, ultimately contributing to improved wellness outcomes across the region.

Appendices

Sara Abdelwahab Shahin coordinated the expert panel. The coordinator formulated the draft statements through comprehensive literature reviews and discussion of available evidence. It was not directly adapted from any single published study or any other direct source.

PubMed		
Search terms	Inclusion	Exclusion
Herbals terms: (“Rhodiola” OR “Rhodiola rosea” OR “Ashwagandha” OR “Withania somnifera” OR “Chamomile” OR “Matricaria chamomilla” OR “Panax ginseng” OR “Ginseng” OR “valerian root” OR “Valeriana officinalis” OR “Lavender” OR “Lavandula angustifolia” OR “Passionflower” OR “Passiflora incarnata” OR “Lemon balm” OR “Melissa officinalis” OR “Echinacea” OR “Echinacea purpurea” OR “Echinacea angustifolia” OR “Echinacea pallida” OR “Elderberry” OR “Sambucus nigra”)title/abstract Indication terms: (“sleep” OR “insomnia” OR “sleep disorders” OR “SDS” OR “depression” OR “mental care” OR “mental state” OR “mental condition” OR “mental health” OR “psychic health” OR “biologic stress” OR “psychologic stress” OR “stress” OR “stress reaction” OR “psychological stress” OR “anxiety” OR “anxiety disorder” OR “generalized anxiety disorder” OR “GAD” OR “immune health” OR “immune function” OR “immune response” OR “immunomodulation” OR “immunostimulant” OR “immune resilience” OR “innate immunity” OR “adaptive immunity” OR “cytokine response”) title/abstract Geography terms: (“Middle East and Africa region” OR “MEA region” OR “MEA” OR "Middle East" OR "Africa" OR "North Africa" OR “Middle East and North Africa region” OR “MENA" OR "Sub-Saharan Africa" OR "Arab countries" OR "Gulf States" OR “Saudi Arabia” OR “United Arab Emirates” OR “UAE” OR “Qatar” OR “Oman” OR “Bahrain” OR “Kuwait” OR “Jordan” OR “Lebanon” OR “Syria” OR “Iraq” OR “Iran” OR “Israel” OR “Palestine” OR “Yemen” OR “Egypt” OR “Turkey” OR “Algeria”) title/abstract	Study type Randomized controlled trials (RCTs), Cross-sectional studies, Systematic reviews and meta-analyses Intervention Herbals (Rhodiola, Ashwagandha, Chamomile, Ginseng, Valerian, Lavender, Passionflower, Lemon balm, Echinacea, Elderberry) Herbal-micronutrient combinations (vitamin/minerals) Population General population Outcomes Stress resilience, Improved sleep quality and immune health support	Editorials, commentaries, and letters. Studies with insufficient data, such as those without clear outcome measures or inadequate reporting. Population with serious diseases like diabetes, cardiovascular disease, neurological disorders etc. Studies containing formulations with two or more combined herbal ingredients were excluded to prevent confounding effects associated with multi-component products.
Embase		
Search terms	Inclusion	Exclusion
Herbal terms: 'withania somnifera':ti,ab,kw OR 'rhodiola':ab,ti OR 'rhodiola rosea':ti,ab,kw OR chamomile:ti,ab,kw OR 'matricaria chamomilla extract':ti,ab,kw OR 'matricaria chamomilla':ti,ab,kw OR 'ginseng':ti,ab,kw OR 'valerian':ti,ab,kw OR 'lavender':ti,ab,kw OR 'passion flower':ti,ab,kw OR 'passiflora incarnata extract':ti,ab,kw OR 'melissa officinalis':ti,ab,kw OR 'lemon balm':ti,ab,kw OR 'echinacea':ti,ab,kw OR 'echinacea purpurea':ti,ab,kw OR 'echinacea extract':ti,ab,kw OR 'sambucus':ti,ab,kw OR 'elderberry extract':ti,ab,kw Indication terms: 'sleep':ti,ab,kw OR 'sleep disorder':ab,ti OR 'insomnia':ti,ab,kw OR 'depression':ti,ab,kw OR 'mental health':ti,ab,kw OR 'mental function':ti,ab,kw OR 'mental disease':ti,ab,kw OR 'physiological stress':ti,ab,kw OR 'anxiety':ti,ab,kw OR 'anxiety disorder':ti,ab,kw OR 'generalized anxiety disorder':ti,ab,kw OR 'immune system':ti,ab,kw OR immune:ti,ab,kw OR 'immune function':ti,ab,kw OR 'immune response':ti,ab,kw OR 'immunomodulation':ti,ab,kw OR 'immunostimulating agent':ti,ab,kw OR immunostimulant:ti,ab,kw OR 'innate immunity':ti,ab,kw OR 'adaptive immunity':ti,ab,kw OR 'cytokine response':ti,ab,kw Geography terms: 'middle east':ti,ab,kw OR 'middle eastern/north african':ab,ti OR 'africa':ti,ab,kw OR 'africa south of the sahara':ti,ab,kw OR 'arab countries':ti,ab,kw OR 'saudi arabia':ti,ab,kw OR 'united arab emirates':ti,ab,kw OR 'qatar':ti,ab,kw OR 'oman':ti,ab,kw OR 'bahrain':ti,ab,kw OR 'kuwait':ti,ab,kw OR 'jordan':ti,ab,kw OR 'lebanon':ti,ab,kw OR 'syrian arab republic':ti,ab,kw OR 'iraq':ti,ab,kw OR 'iran':ti,ab,kw OR 'israel':ti,ab,kw OR 'palestine':ti,ab,kw OR 'yemen':ti,ab,kw OR 'egypt':ti,ab,kw OR 'turkey':ti,ab,kw OR 'algeria':ti,ab,kw	Study type Randomized controlled trials (RCTs), Cross-sectional studies, Systematic reviews and meta-analyses Interventions Herbals (Rhodiola, Ashwagandha, Chamomile, Ginseng, Valerian, Lavender, Passionflower, Lemon balm, Echinacea, Elderberry) Herbal-micronutrient combinations (vitamin/minerals) Population General population Outcomes Stress resilience, Improved sleep quality and immune health support	Editorials, commentaries, and letters. Studies with insufficient data, such as those without clear outcome measures or inadequate reporting. Population with serious diseases like diabetes, cardiovascular disease, neurological disorders etc. Studies containing formulations with two or more combined herbal ingredients were excluded to prevent confounding effects associated with multi-component products.

TABLE 2: Search strategy for Embase and PubMed

Authors	Country	Indication	Herbal interventions	Study design	Key findings
Role of herbals in managing stress					
Rhodiola (*Rhodiola rosea*)					
Cropley et al. (2015) [42]	United Kingdom	Stress	Group A: Rhodiola (*Rhodiola rosea* L): 200 mg; Group B: Control	Randomized, open-label, repeated-measures clinical trial	Significant reduction in anxiety and perceived stress at Day 14 (both $p < 0.01$)
Darbinyan et al. (2007) [43]	Armenia	Stress	Group A: Rhodiola (*Rhodiola rosea*): 340 mg; Group B: Rhodiola (Rhodiola rosea): 680 mg/day; Group C: Placebo	Double-blind, placebo-controlled trial	Mean total HAMD scores declined in both treatment groups ($p < 0.001$)
Olsson et al. (2009) [44]	Sweden	Stress	Group A: Rhodiola (*Rhodiola rosea*) extract SHR-5: 576 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Cortisol response to awakening stress changed significantly following treatment; Significant decrease in Pines' burnout scale ($p = 0.047$)
Kasper and Dienel (2017) [45]	Austria	Stress	Rhodiola (*Rhodiola rosea*) extract: 400 mg	Open-label, single-arm clinical trial	NAS for subjective stress improved in the first week of treatment ($p < 0.001$); Improved PSQ stress score ($p < 0.001$)
Lekomtseva et al. (2017) [46]	Ukraine	Stress	Rhodiola (*Rhodiola rosea*): 200 mg	Open-label, single-arm clinical trial	PSQ-R stress score reduced ($p < 0.0001$); Improved BDI-II score ($p < 0.0001$)
Edwards et al. (2012) [47]	United Kingdom	Stress	Rhodiola (*Rhodiola rosea*): 200 mg	Non-randomized, open-label, single-arm clinical trial	Significant decrease in the intensity of stress symptoms indicated by NAS ($p < 0.0001$); Improved Perceived Stress Questionnaire ($p < 0.0001$)
Chamomile (*Matricaria chamomilla*)					
Rehim et al. (2025) [51]	Egypt	Stress	Group A: Control group; Group B: Lavender essential oil (*Lavandula angustifolia*); Group C: Chamomile essential oil (*Matricaria chamomilla*); Group D: Peppermint essential oil	Randomized, triple-blind, controlled trial	Significant decrease in anxiety score in chamomile group ($p < 0.001$)
Ebrahimi et al. (2022) [34]	Iran	Stress	Group A: Lavender essential oil (*Lavandula angustifolia*); Group B: Chamomile essential oil (*Matricaria chamomilla*); Group C: Control	Randomized, triple-blind, controlled trial	Significant difference in anxiety and stress scores in chamomile group ($p < 0.001$ and $p < 0.001$) vs control
Eskandari et al. (2023) [52]	Iran	Stress	Group A: Swedish massage with chamomile oil (*Matricaria chamomilla*); Group B: Swedish massage without chamomile oil; Group C: Control group	Randomized clinical trial	Significant reduction in average anxiety score indicated by the Vandenberg Anxiety Questionnaire ($p < 0.001$)
Heidari-Fard et al. (2017) [53]	Iran	Stress	Group A: Chamomile essential oil (*Matricaria chamomilla*): 2 drops; Group B: Control	Randomized clinical trial	Significant decrease in anxiety level ($p < 0.005$) vs control
Sharifi et al. (2014) [54]	Iran	Stress	Group A: Chamomile (*Matricaria chamomilla*) capsule: 100 mg; Group B: Mefenamic acid: 250 mg	Randomized, double-blind clinical trial	Significant reduction in intensity of depression and anxiety ($p < 0.001$ and $p < 0.001$)
Rafii et al. (2020) [55]	Iran	Stress	Group A: Control group; Group B: Placebo group; Group C: Aromatherapy massage of chamomile (*Matricaria chamomilla*)	Randomized clinical trial	Significant reduction in anxiety score ($p < 0.001$)
Ashraf et al. (2021) [56]	Iran	Stress	Chamomile (*Matricaria chamomilla*)	Cross-sectional	46.9% of participants reported using chamomile as complementary therapy.

				study	
Ashwagandha (*Withania somnifera*)					
Fuladi et al. (2021) [62]	Iran	Stress	Group A: Ashwagandha (*Withania somnifera*) extract: 1 g/day; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significant reduction in HAM-A score ($p < 0.05$) and GAD score between the second ($p = 0.04$) and sixth week ($p = 0.02$)
Lopresti et al. (2019) [57]	India	Stress	Group A: Standardized Ashwagandha (*Withania somnifera*) extract: 240 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significant reduction in the HAM-A ($p = 0.040$)
Gopukumar et al. (2021) [64]	India	Stress	Group A: Ashwagandha root (*Withania somnifera*) extract sustained-release capsule: 300 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled study	Significantly lower PSS scores ($p < 0.0001$), serum cortisol levels ($p = 0.0443$) and higher OHQ scores ($p < .0001$)
Mahadevan et al. (2025) [67]	India	Stress	Group A: Ashwagandha (*Withania somnifera*) formulation; Group B: Placebo	Prospective, randomized, double-blind, parallel, placebo-controlled	Significant improvement in PSS and BAI scores (both $p < 0.05$)
Langade et al. (2019) [65]	India	Stress	Group A: Ashwagandha root (*Withania somnifera*) extract: 300 mg capsule; Group B: Placebo	Randomized, double-blind, placebo-controlled study	Significant decrease in the HAM-A score after 10 weeks ($p = 0.002$)
Baker et al. (2022) [63]	USA	Stress	Group A: Extract of Ashwagandha root (*Withania somnifera*): 700 mg; Group B: placebo	Randomized, double-blind, placebo-controlled trial	Improved perceived well-being and reduced stress-related scores ($p = 0.001$).
Leonard et al. (2024) [66]	USA	Stress	Group A: Ashwagandha root and leaf extract (*Withania somnifera*): 225 mg; Group B: Placebo	Retrospective, randomized, double-blind clinical trial	Significant time effects in tension ($p < 0.001$), depression ($p < 0.001$), and fatigue ($p < 0.001$) (under Profile of Mood States)
Ginseng (Panax ginseng)					
Al-Kuraishy and Al-Gareeb (2017) [72]	Iraq	Stress	Group A: Ginseng (*Panax ginseng*): 500 mg/day; Group B: Placebo	Randomized, single-blind, placebo-controlled study	Significant reduction in MDA serum levels ($p < 0.01$); Significant increase in perceived stress scale ($p = 0.02$).
Mesbahi et al. (2025) [73]	Iran	Stress	Group A: Ginseng (*Panax ginseng*): 100 mg; Group B: Placebo	Randomized controlled trial	No significant difference in HDRS and HARS scores
Dormal et al. (2025) [74]	Belgium	Stress	Group A: Ginseng (*Panax ginseng*) supplementation 200 mg/day; Group B: Placebo	Randomized, double-blind, placebo-controlled study	Significant improvement in the PSS score ($p = 0.040$)
Shim et al. (2025) [75]	Republic of Korea	Stress	Group A: Ginseng (*Panax ginseng*) capsule: 495 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significantly lower composite stress index ($p = 0.025$)
Baek et al. (2019) [76]	Republic of Korea	Stress	Group A: Ginseng (*Panax ginseng*) capsule: 500 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significant increase in triglyceride levels ($p = 0.048$) and associated decrease in epinephrine ($p = 0.043$); No significant improvement in stress-measuring scales (BDI and SRI)

Role of herbals in managing sleep					
Valerian root (*Valeriana officinalis*)					
Jokar et al. (2016) [84]	Iran	Sleep	Group A: Valerian (*Valeriana officinalis*); Group B: Relaxation; Group C: Control	Randomized clinical trial	Significant difference in sleep quality score ($p < 0.001$)
Taavoni et al. (2011) [85]	Iran	Sleep	Group A: Concentrated valerian extract (*Valeriana officinalis*): 530 mg; Group B: Placebo	Randomized, triple-blind, controlled trial	Significant change in PSQI ($p < 0.001$) vs placebo
Wazaify et al. (2019) [86]	Jordan	Sleep	Valerian (*Valeriana officinalis*)	Cross-sectional study	Valerian-based herbal products were supplied in 34.3% of insomnia-related encounters, making them a commonly used non-pharmacological option
Lavender (Lavandula angustifolia)					
Kamalifard et al. (2018) [92]	Iran	Sleep	Group A: Bitter orange (*Citrus aurantium*) capsule: 500 mg; Group B: Lavender flower powder (*Lavandula angustifolia*) capsule: 500 mg; Group C: Starch capsule: 500 mg	Randomized, triple-blind, controlled trial	Significantly improved mean sleep score (PSQI) in lavender group ($p = 0.003$) vs control group
Effati-Daryani et al. (2018) [95]	Iran	Sleep	Group A: Lavender (*Lavandula angustifolia*) and footbath; Group B: Lavender (*Lavandula angustifolia*) alone; Group C: Placebo cream	Randomized controlled trial	Significantly lower PSQI score with intervention during pregnancy ($p < 0.001$) and after delivery ($p < 0.001$) vs placebo
Afshar et al. (2015) [94]	Iran	Sleep	Group A: Lavender fragrance (*Lavandula angustifolia*); Group B: Placebo	Randomized clinical trial	Significant decrease in PSQI after 8 weeks of intervention ($p = 0.002$) vs placebo
Genç et al. (2020) [97]	Turkey	Sleep	Group A: Aromatherapy with 3% lavender oil (*Lavandula angustifolia*); Group B: Control	Randomized controlled trial	Significant decrease in PSQI after intervention ($p = 0.001$) vs control
Nasiri and Fahimzade (2017) [98]	Iran	Sleep	Group A: Lavender (*Lavandula angustifolia*) essential oil; Group B: Placebo	Randomized controlled trial	Improved mean score of total sleep quality ($p < 0.001$) vs placebo
Kavurmacı et al. (2022) [100]	Turkey	Sleep	Group A: Lavender essential oil (*Lavandula angustifolia*); Group B: Control	Randomized clinical trial	Significant reduction in PSQI score ($p = 0.001$) vs control
Passionflower (*Passiflora incarnata*)					
Ngan and Conduit (2011) [101]	Australia	Sleep	Group A: Placebo; Group B: Passionflower (*Passiflora incarnata*) herbal tea	Double-blind, placebo-controlled trial	Better sleep quality with Passiflora herbal tea ($p < 0.01$) vs placebo
Lee et al. (2020) [103]	Republic of Korea	Sleep	Group A: Passionflower (*Passiflora incarnata*) extract: 60 mg; Group B: Placebo tea	Randomized, double-blind, placebo-controlled trial	Significant improvement in sleep efficiency and WASO in the Passionflower group ($p = 0.008$, $p = 0.025$); TST increased ($p = 0.049$) vs placebo
Harit et al. (2024) [104]	India	Sleep	Group A: Passionflower (*Passiflora incarnata*) extract: 600 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled study	Significant increase in mean total sleep time ($p < 0.05$); Significantly shorter "time to sleep onset" ($p < 0.05$); Improved sleep quality indicated by PSQI ($p < 0.05$) in the intervention group from baseline
Lemon balm (Melissa officinalis)					
Gürol et al. (2019) [109]	Turkey	Sleep	Lemon balm (*Melissa officinalis*)	Cross-sectional study	28% of mothers use lemon balm to mitigate sleep issues in their children
Sinaei et al.			Group A: Aromatherapy with the	Randomized	Significant decrease in PSQI within ($p <$

(2024) [110]	Iran	Sleep	lemon balm essential oil (*Melissa officinalis*); Group B: Control	clinical trial	0.001) vs control (p < 0.001)
Role of herbals in managing immunity					
Ashwagandha (*Withania somnifera*)					
Tharakan et al. (2021) [114]	India	Immune health	Group A: Ashwagandha (*Withania somnifera*) extract: 60 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significant increase in antibodies, cytokines, and TBNK cells (p < 0.05)
Kulkarni-Munshi et al. (2025) [115]	India	Immune health	Group A: Oral Ashwagandha (*Withania somnifera*): 500 mg; Group B: Hydroxychloroquine (HCQ): 400 mg	Randomized controlled trial	Statistically significant difference in cytokine levels for TNF-α, IL-2, IL-10, IL-17 and MCP-1 at 12 weeks compared to baseline (p < 0.0001)
Ginseng (*Panax ginseng*)					
Yang et al. (2024) [122]	China	Immune health	Group A: Korean Red Ginseng (*Panax ginseng*) capsule; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significantly improved IgA and immune scores, increased WBC, monocytes and neutrophils vs placebo (p < 0.05, p < 0.01, p < 0.05, p < 0.05, p < 0.05, p < 0.05)
Hyun et al. (2021) [123]	Republic of Korea	Immune health	Group A: Korean Red Ginseng (*Panax ginseng*): 2 g; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Increase in T cell number and associated changes in them (p = 0.0191; p = 0.0348); B cell distribution increased (p = 0.0061); Increase in WBC (p = 0.0490) vs placebo
Scaglione et al. (1996) [117]	Italy	Immune health	Group A: Ginseng (*Panax ginseng*) extract: 100 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significantly fewer cases of common cold or influenza (p < 0.0001); Increase in NK cell activity and antibody titer (p < 0.0001) vs placebo
Lee et al. (2012) [120]	Republic of Korea	Immune health	Group A: Concentrated red ginseng (*Panax ginseng*): 1 g; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significantly lower ARI frequency (p = 0.034); Low rate of cough (p = 0.045)
Cho et al. (2014) [124]	Republic of Korea	Immune health	Group A: Y-75 ginseng polysaccharide (*Panax ginseng*): 6 g; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significant increase in NK activity (p = 0.0012), phagocytic activity (p = 0.0018), TNF-α levels (p = 0.0319) vs placebo
Echinacea (*Echinacea purpurea*)					
Goel et al. (2005) [132]	Canada	Immune health	Group A: Echinacea (*Echinacea purpurea*) extract formulation; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Reduction in total daily symptom scores (p < 0.05); significant and sustained increases in circulating WBCs, including monocytes (p = 0.01), neutrophils (p = 0.02), and NK cells (p = 0.05), after 7 days of treatment.
Goel et al. (2004) [131]	Canada	Immune health	Group A: Echinacea (*Echinacea purpurea*) extract formulation; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	23.1% reduction in total daily symptom scores of common cold (p < 0.01)
O'Neil et al. (2008) [134]	United States	Immune health	Group A: Echinacea (*Echinacea purpurea*) capsule: 300 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	No significant improvement in frequency of upper respiratory tract symptoms
Yale and Liu (2004) [135]	United States	Immune health	Group A: Echinacea (*Echinacea purpurea*) extract: 300 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	No significant difference was observed in total symptom scores or mean individual symptom scores
Schulten et al. (2001) [133]	Germany	Immune health	Group A: Echinacea (*Echinacea purpurea*) pressed juice: 5 mL; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Recovery from common cold symptoms was faster in the treatment group than in the placebo group (6 vs 9 days; p = 0.0112).

Elderberry (*Sambucus nigra*)					
Zakay-Rones et al. (1995) [141]	Israel	Immune health	Group A: Elderberry (*Sambucus nigra*) extract; Group B: Placebo	Placebo-controlled study	Significantly improved symptoms vs placebo ($p < 0.001$)
Zakay-Rones et al. (2004) [142]	Norway	Immune health	Group A: Elderberry (*Sambucus nigra*) syrup: 15 mL; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Shortened recovery by 4 days vs placebo ($p < 0.001$); Reduction in rescue medication ($p < 0.001$)
Tiralongo et al. (2016) [143]	Australia	Immune health	Group A: Elderberry (*Sambucus nigra*) extract: 300 mg; Group B: Placebo	Randomized, double-blind, placebo-controlled trial	Significant reduction in cold duration and symptom score ($p = 0.02$, $p = 0.05$) vs placebo

TABLE 3: Role of herbals in stress resilience, improve sleep-quality and support immune health

HAMD: Hamilton Depression Rating Scale; ISI: Insomnia Severity Index; BAI: Beck Anxiety Inventory; NAS: Numerical Analogue Scale; PSQ: Perceived Stress Questionnaire; PSS: Perceived Stress Scale; OHQ: Oxford Happiness Questionnaire; DASS-42: Depression Anxiety Stress Scales-42; POMS: Profile of Mood States; GAD: Generalized Anxiety Disorder; HAM-A: Hamilton Anxiety Rating Scale; MDA: Mood and Depression Assessment; HDRS: Hamilton Depression Rating Scale; HARS: Hamilton Anxiety Rating Scale; PSQI: Pittsburgh Sleep Quality Index; WASO: wake after sleep onset; TST: total sleep time; JSS: Jenkins Sleep Scale; BDI: Beck Depression Inventory; SRI: Stress Response Inventory; TNF-α: tumor necrosis factor alpha; IL: interleukin; MCP-1: monocyte chemoattractant protein-1.

Authors	Country	Indication	Herbal-micronutrient interventions	Study design	Key findings
Tardy et al., 2021 [146]	Spain	Stress	Group A: Ginseng (*Panax ginseng*): 40 mg/day formulated with vitamins and minerals	Open-label, single-arm trial	A significant overall improvement in fatigue-related perception rating, including stress
Radhakrishnan et al., 2023 [147]	United States	Immune health	Group A: EZC Pak (Day 1: Echinacea (*Echinacea purpurea*): 2200 mg; Zinc: 100 mg; Vitamin C: 1000 mg; Day 2: 75% of Day 1; Days 3–5: 50% of Day 1); Group B: Day 1: EZC Pak + Vitamin D: 4000 IU, then tapered as above) Group C: Placebo	Randomized, double-blind placebo-controlled trial	Faster recovery (1.39 days); Lower symptom severity score; 2.9 times higher patient satisfaction
Caso Marasco et al., 1996 [148]	Mexico	Stress	Group A: Ginseng (*Panax ginseng*) extract and vitamins, minerals, trace elements capsules; Group B: Vitamins, minerals and trace elements capsules	Randomized double-blind comparative trial	Improved quality of life index among individuals subjected to high physical and mental activity

TABLE 4: Role of herbals-micronutrient combinations in stress resilience and immune health support

DASS-42: Depression Anxiety Stress Scales-42; EEG: electroencephalography.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** The expert panel meeting was funded by Haleon. The sponsors had no influence on this study's methodology, results, or discussion. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** Sara Abdelwahab Shahin is currently an employee of Haleon. Other authors declare no conflict of interest.

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