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Tea and Herbal Infusions, Psychological Stress, Anxiety & Sleep Health: A Systematic Review of Human Trials & Mechanistic Studies

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Abstract

Tea is popular global beverage and abundant provider of biologically active plant molecules which have been attributed to its health properties. Relationships between tea drinking and certain aspects of health have been the subject of past reviews. The present systematic review focuses on tea consumption in relation to psychological stress and the challenges of stress and anxiety on sleep health. Publications were searched up to 21st September 2022, in the PubMed database along with references of original articles. Thirty-three publications were included in the main review-17 human trials and 16 mechanistic studies. Human trials were graded to assess quality using the Jadad scale. Overall, a growing body of evidence suggests that tea (including green and oolong) and herbal infusions, at relatively low intakes (around 1 to 2 cups daily), could help to facilitate sleep, alleviate psychological stress and anxiety, primarily by facilitating relaxation. Evidence for black tea, German Chamomile, Lavender, Rose, Jasmine, and Passionflower tea is emerging and looks promising. Ongoing research is needed in the form of randomised controlled trials to build on these provisional findings.

Keywords: Anxiety; Black tea; Gamma-Aminobutyric Acid (GABA); Green tea; Herbal infusions; Herbal teas; L-Theanine; Polyphenols; Sleep

Introduction

Stress has been defined as a state of homeostasis with inadequate stress (sustress) and heightened stress (distress) potentially impairing normal physiological functions and eustress (the homeostatic state between sustress and distress) being most favorable [1]. Anxiety relates to the mind and body's anticipation of stressful, unfamiliar or dangerous situations which in extreme instances can become debilitating e.g. in the case of anxiety disorders which include: general anxiety disorders, obsessive-compulsive and related disorders and trauma-and stressor-related disorders [2]. Both stress and anxiety can affect sleep, a concept known as 'sleep reactivity' [3]. This is the level to which stress disturbs sleep, resulting in challenges in falling and staying asleep [3]. Increased anxiety levels have been identified as a consequence of sleep deprivation, with a meta-analysis of 18 publications (compiled of 34 experiments) confirming that sleep deprivation results in a heightened state of anxiety [4]. In the corona virus pandemic negative changes in sleep have been linked to increased stress and anxiety symptoms [5].

The term 'sleep health' is used infrequently compared with other terms such as 'bone' or 'brain' health [6]. Yet good sleep is central to good health [7,8]. Sleep health is a multidimensional concept with five main dimensions appearing to be most relevant (Figure 1) [6]. Given this, sleep health has been defined as "A multidimensional pattern of sleep-wakefulness, adapted to individual, social, and environmental demands, that promotes physical and mental well-being. Good sleep health is characterized by subjective satisfaction, appropriate timing, adequate duration, high sleep efficiency, and sustained alertness during waking hours" [6]. This definition was devised for adults but can be adapted to other populations such as adolescents and children [6].

The American Academy of Sleep Medicine and the Sleep Research Society both recommend that most adults should sleep between 7-9 hours nightly to promote health [9]. Sleep durations of 9 hours or more may be more appropriate for young adults, those with sleep debt or medical illnesses [9]. The National Sleep Foundation similarly recommends that young adults and adults should aim for 7 to 9 hours sleep [10]. A meta-analysis of 1.1 million people from the United Kingdom, Netherlands and United States concluded that 1 in 4 people had less sleep than age-specific benchmarks. Women 41-years or older had shorter sleep and poorer sleep efficiencies (the ratio between the time a person spends asleep and total time dedicated to sleep) than men of the same age. Half (51.5%) of the included teenagers reported total sleep times below the advised 8 to 10 hours a night [11]. Another assessment of 80,000 mid-life adults living in the United Kingdom found that one-third slept for around 6-7 hours a night whilst high coffee intake, social deprivation and older age were associated with

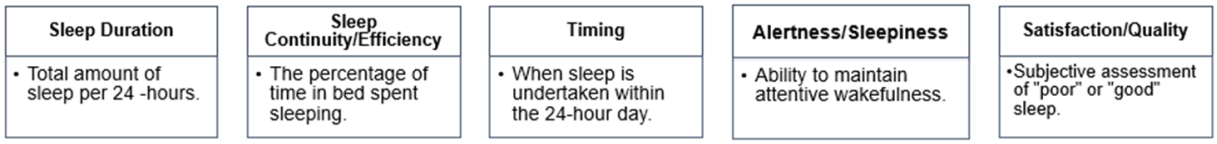

Figure 1: Five Dimensions Most Relevant to Definitions and Measurements of Sleep Health.

shorter sleep durations (i.e. less than 6 hours nightly) [12]. Sleep duration has also been correlated with certain biological biomarkers, with levels of C-reactive protein (an inflammatory biomarker) and gamma glutamyl transferase (a liver function biomarker) found to be 14% higher in those having <6 hours compared to 7-8 hours of sleep a night [13].

The ramifications of sleep loss are far reaching [9,14]. Sleeping for less than 7 hours nightly has been linked to increased risk of developing diabetes, weight gain, obesity, heart disease, hypertension, stroke, depression, impaired immune function, impeded performance, increased errors, exacerbated risk of accidents and all-cause mortality [9]. Sleep loss can impair cognitive and task performance, attention and memory, heighten fatigue, and impede decision-making [15,16]. Sleep disturbances and depression share an intricate and bidirectional relationship [17]. Moreover, a recent meta-analysis of 65 trials consisting of 72 interventions and a sample size of 8608 adults identified a dose response relationship between greater improvements in sleep quality in relation to better mental health [18]. An umbrella review also found that a 1-hour daily reduction in sleep duration (per 24-hours) was associated with an 3 to 11% increased risk of all-cause mortality and risk of stroke, coronary heart disease, type two diabetes mellitus and osteoporosis [19]. Poor sleep can also affect the regulation of hormones (those influencing metabolism and hunger) involved in appetite and weight regulation thus predisposing an individual towards obesity [20]. Habitual sleeping patterns <7 hours nightly have been further linked to increased respiratory tract infection susceptibility [21,22].

The natural cycle of life revolves around: 1) awakening, 2) eating and drinking, 3) surviving and 4) returning to sleep [23]. Focusing on drinking habits, it should be recognised that amongst adults tea drinking patterns in relation to the frequency, form and amount of tea can vary [24]. European data from the EPIC (European Prospective Investigation into Cancer and Nutrition) study has shown that patterns of tea intake range from 14 g/Day (0.1 cups) in Navarra (Spain) and were up to 788 g/day (around 4.3 cups) in the UK population and similar patterns were also observed by men [25].

Herbal infusions are increasingly being recognised as being a therapeutic vehicle delivering benefits in certain aspects of clinical and preventative health [26]. There are around 3 billion people who enjoy drinking tea and infusions globally with this seen as an inexpensive complementary alternative medicine [27]. It has been previously reported that tea and herbal infusions are a valuable source of flavonoids and other polyphenols and that ingestion (around 1 to 3 cups daily) could potentially benefit certain aspects of health [28]. In particular, L-theanine, an amino acid naturally found in green and black tea (*Camellia sinensis*) is thought to help attenuate the negative effects of psychological stress and anxiety on health [29]. The present systematic review focuses on tea (including green and oolong tea) and herbal in fusions and how their ingestion could specifically impact on stress, anxiety, and dimensions of sleep health.

Materials and Methods

Search strategy & study selection

The National Library of Medicine, National Center for Biotechnology Information PubMed.gov data base was used to filter, screen, and identify relevant publications. In Phase 1publications were restricted to: (1) articles with an English abstract (2) Randomized Controlled Trials (RCTs) (3) clinical trials and (4) publications using tea infusions only.

In Phase 1 the search terms 'tea and sleep*', 'tea and anxiety' and 'tea and psychological stress' were applied. The asterisk (*) was applied to capture studies using extensions of the word 'sleep' such as sleeping. No time restrictions were applied. The term 'psychological stress' was used as studies relating to 'oxidative stress' were deemed irrelevant. Observational studies were excluded from the present review as cause-and-effect relationships are more difficult to decipher from these studies [22]. A PICO model formed the basis of the search strategy [30]. The Population (P) was defined as young people and adults which included older adults and pregnant/postpartum mothers. The Intervention (I) that was considered was tea and herbal infusions. The Comparison (C) was a defined control or placebo group, and the Outcomes of interest (O) were sleep, anxiety and psychological stress.

Phase 1 followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and 2020 Checklist [15]. Publications using tea capsules, tablets, supplements, multiple-component teas, multi-interventions e.g., tea and supplements, extracts, or oils were excluded. Reference lists were also searched for further relevant publications. ED and TB identified and screened the articles which were compared against the inclusion/exclusion criteria. Any disagreements were to be outlined to JE to make a decision, no disputes were apparent.

Similar terms were applied in Phase 2. No time restrictions were applied. The filter was restricted to only include results from animal studies using the category 'other animals' to identify mechanistic studies. After reviewing and identifying relevant publications, suitable trials had data extrapolated including: Study (author, year, location), subjects, study design, tea intervention (type), tea intervention (dosage), the sleep dimensions studied, main findings and Jadad quality score. The algorithm used to select studies is displayed in Figure 2.

To determine quality scores for each human trial, the Jadad criterion was applied with scores of 1–5 being allocated (5 indicated that trials were of a higher quality) [16]. This included analyzing whether randomization, methods of randomization, blinding, methods of blinding and reporting of withdrawal and dropout were appropriate and described adequately in the studies identified [16].

Results

For Phase 1, 65 results were obtained and 28 RCTs and clinical trials identified for screening. A further 11 publications were identified

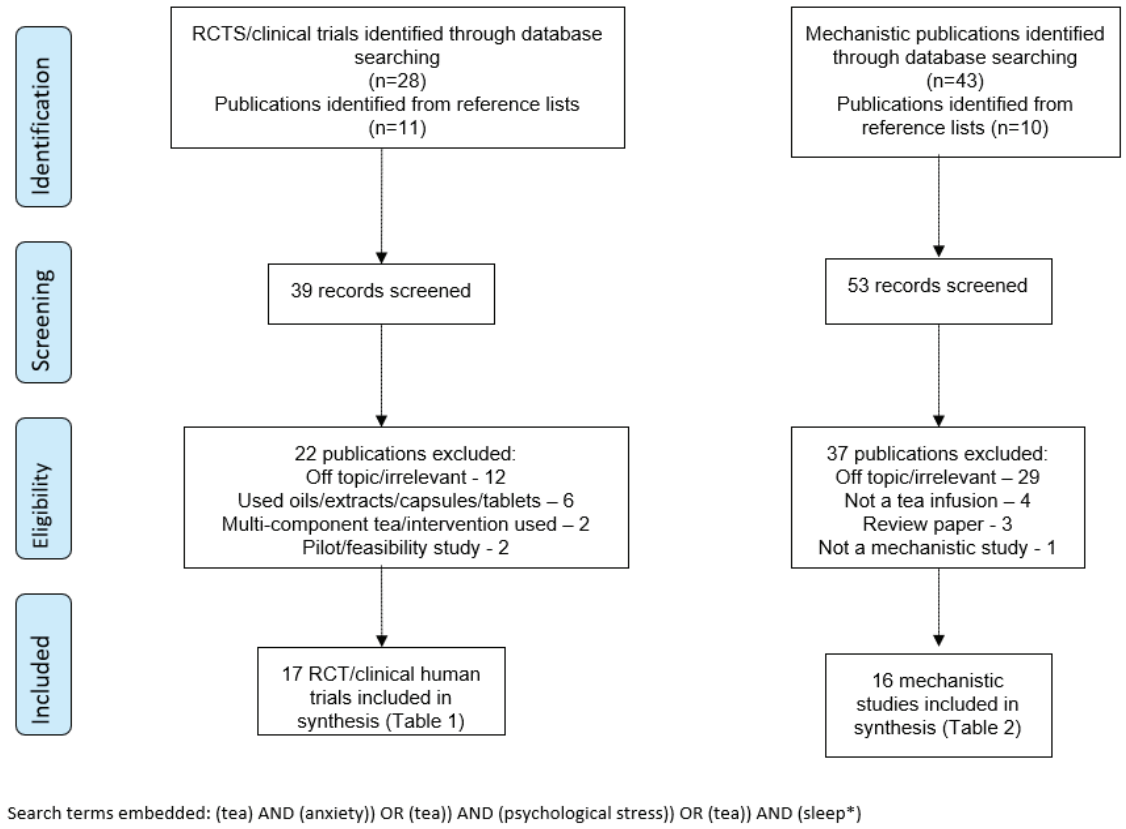

Figure 2: PRISMA Algorithm used to Identify Trials.

from reference lists. Subsequently, 39 publications were screened and 22 excluded due to these being off topic or irrelevant (n=12), using interventions that were not a tea infusion (n=6), applying multi-interventions (n=2) or being a pilot or feasibility study (n=2) leaving 17 publications which were included in the review. The algorithm of qualifying publications is shown in figure 2.

In Phase 2 the search yielded 139 publications after restricting the search to 'other animals'. Of these 43 were deemed relevant for further screening. A further 10 publications were identified from reference lists. After excluding studies that were irrelevant, did not use tea infusion/components, were review papers or not a mechanistic study 16 publications were identified for the main review.

Human trials

Psychological stress and anxiety: Seven key human trials were identified investigating links between tea ingestion and markers of psychological stress and anxiety which affect sleep and sleep patterns (Table 1). Of these two focused on green tea [31,32] whilst others studied the role (s) of lavender tea [33], rose tea [34] or black/instant tea aroma forms [35-37]. The studies showed that the various tea forms help to lower markers of stress and anxiety and aid relaxation. For example, amongst elderly adults' lavender tea ingestion (twice daily) resulted in lower anxiety and depression levels in the tea compared with the control group [33]. Similarly, for rose tea, 2 tea cups ingested daily, each approximately 300 mL resulted in lower perceived levels of anxiety and improved psycho physiological well being [34].

For green tea, amongst a population of younger adults (mean age 23 years) 500 mL matcha green tea (around 2 cups) was associated with significantly lower anxiety levels determined using the state-trait anxiety inventory [31]. Yoto, et al. (2014) found that salivary chromogranin A levels increased after mental stress load tasks and green tea ingestion inhibited this [32]. Samant, et al. (2016) found that tea consumption appeared to induce a state of calmness particularly that sweetened with nutritive sweetener [36]. Similarly, earlier work by Steptoe and colleagues (2007) showed that 6-weeks of tea consumption could aid stress recovery [37]. Other research work showed that the inhalation of black tea could reduce stress following mental arithmetic tasks (sometimes referred to as math's anxiety) [35]. These findings suggest that tea (in an array of forms) may attenuate feelings of anxiety and stress. Replications of such studies are now needed.

Sleep health: A growing number of human trials have investigated the role of tea and herbal infusions in relation to the various dimensions of sleep health. Ten human trials were identified and synthesized in the present review (Table 1). Of these, two focused on oolong tea [38,39], two reported on green tea, including standard and low-caffeine green tea [40,41], two studied regular or black tea [42,43] and the others investigated Chamomile (German) tea [44], lavender tea [45], passionflower tea [46] or a combination of three different herbal teas [47].

Several different methodologies were adopted to evaluate dimensions of sleep health. This included the use of Electroencephalograph (EEG) in two trials [40,41], polysomnography [39], an actiwatch

Table 1: Phase 1: Tea Infusions, Psychological Stress, Anxiety and Sleep Health: Evidence from Human Trials.

Study	Subjects	Study design	Tea Intervention (type)	Tea Intervention (Dosage)	Methodology	Main findings	JADAD Score
Psychological stress & Anxiety							
Bazrafshan, et al. Iran [33]	n=60 elderly participants (30 in each group)	2-week RCT	Lavender tea	2 g of lavender teabag used 2 times daily as a decoction in the morning and night	Beck Depression Inventory, Spielberger State and Trait Anxiety Inventory	Mean difference of intervention and control groups after drinking herbal tea in terms of depression and anxiety were (-2.00, 95 % CI (-2.86, -1.13)), (-6.40, 95 % CI (-9.43, -3.36)) and (-4.13, 95 % CI (-7.66, -0.60)), respectively	3
Unno, et al. Japan [31]	n=39 healthy students (23 ± 1.1 years old, 23 men and 16 women)	Randomly divided into two groups: test-matcha (n=19) and placebo-matcha (n=20)	Matcha green tea	Participants consumed 3 g of matcha daily suspended in 500 mL of room-temperature water	Spielberger State and trait anxiety inventory	Anxiety was significantly lower in the test-matcha group than in the placebo group	0
Yoto, et al. Japan [35]	n=18 healthy volunteers (5 males, 13 females; age 20.4 ± 0.81 years)	Black tea, Darjeeling tea	Tea aroma samples were prepared by extracting 3 g of tea leaf with 180 ml 100°C hot water for 5 min	Uchida-Kraepelin (U-K) test for stress load. Salivary chromogranin-A measured		Inhaling black tea aroma lowered stress levels caused by arithmetic mental stress tasks. Darjeeling tea aroma improved mood before mental stress load	2
Samant, et al. USA [36]	n=50 (25 men and 25 women) 22- 70 years.	2-day trial.	Instant tea	Unsweetened instant tea powder was used to prepare the tea beverages. Approximately 90-mL of each sample was provided in a 112-mL cup. Three types of sweeteners were used: pure cane sugar, granulated no calorie sucralose and granulated no calorie stevia	Measured mean anxiety rating and profile of mood states	The ingestion of tea sweetened with nutritive sweetener, but not with non-nutritive sweetener had calming effects on acute stress	0
Yoto, et al. Japan [32]	n=18 students (nine male and nine female)	3 experimental trials on different days at intervals of 7 days	Green tea, shaded white tea	Tealeaves removed and 250 ml of the tea sample was cooled to 25°C and then poured into a paper cup for subjects to drink	Salivary chromogranin-A measured	Salivary CgA concentration levels increased after mental stress load tasks & green tea ingestion inhibited this increase	2
Steptoe, et al. UK [37]	n=75 healthy nonsmoking men.	4-week wash-out phase. Bloods drawn after 6 week intervention.	Tea and fruit flavoured powders	Tea containing 72 mg caffeine and 6.4% flavanols (equivalent to four cups of black tea)	Cortisol levels measured.	The tea group showed lower post-task cortisol levels compared with placebo (P=0.032), and an increase in subjective relaxation (P =0.036)	4
Tseng, et al. Taiwan [34]	n=130 female adolescents	6-month RCT	Rose tea	Drank 2 teacups of rose tea (6 dry rosebuds seeped for 10 minutes in 300mL of hot water per teacup) for 12 days of every months	McGill pain questionnaire, visual analogue scales for anxiety, perceived stress scale	The experimental group perceived less anxiety and had greater psychophysiological well-being through time, at 1, 3, and 6 months	4

Sleep Health							
Hannant, et al. UK [38]	n=9 children (5 males, 4 females)	A feasibility study with clinical trial registration. DB repeated measures design.	Oolong tea	Three tea conditions: 1) high GABA, 2) high L-Theanine (increases GABA) or 3) placebo with low GABA	Sleep monitored using an actiwatch, anxiety using cortisol levels	There were significant improvements in cortisol levels with GABA tea indicating that oolong tea could aid relaxation	3
Zhang, et al. Japan [39]	n=12 non-obese males	2x 14-days randomized, placebo-controlled, DB cross-over trial	Oolong tea	Two cans of test beverage (350 mL/can; 1 can at breakfast and 1 can at lunch): oolong tea (51.8mg caffeine and 48.5mg catechins), 51.8mg caffeine, or placebo	Sleep was recorded by polysomnography.	Two weeks of caffeine or oolong tea ingestion increased fat oxidation by ~20% without altering sleep	3
Baek, et al. Korea [47]	n=20 in tea group and n=20 in control (35-44 years)	8-week randomized controlled pilot study	Combination of 3 herbal teas (Astragali Radix, Angelicaegigantis Radix, and Zizyphi Fructus)	The tea group drank the tea twice daily for 4 weeks. Herbs were dried, roasted, comminuted into pellets, and sealed into tea bags each containing 3 g of each herbal tea	Chalder Fatigue Scale, Pittsburgh Sleep Quality Index	A significant improvement in sleep quality vs. baseline was also observed at 4 weeks (P = 0.002) and 8 weeks (P = 0.026)	4
Unno, et al. Japan [40]	n = 20, 11 males and 9 females (51.3 ± 6.7 years)	7-day DB crossover study.	SGT or LCGT	≥300 mL/day ingested. One tea bag of SGT or LCGT (3 g of tea in each bag) was steeped in 500 mL at room temperature water in a water bottle. Tea bags were left in water until all tea had been fully consumed	Single-channel electroencephalography	Slow wave sleep (an indicator of sleep quality) was significantly higher amongst participants that consumed a larger quantity of LCGT (P=0.045)	3
Unno, et al. Japan [41]	n = 10, 9 females and 1 male (89.3 ± 4.2 years)	3-week single arm and non-randomized design.	Green tea	Tea prepared 5 times daily. Tea bags of low-caffeine green tea (total 20 g) steeped in 2 L of room temperature water for 5 min, and tea bags were well stirred. The tea bags were removed 10 min later and the eluate was warmed to 60–70°C. Standard green tea (total 10 g) was steeped in 2 L of boiling water	Single-channel electroencephalography	While the levels of sAAm were different among individuals, lower sAAm correlated with a higher quality of sleep	3
Chang & Chen, Taiwan [44]	n=40 experimental and n=40 in control group (routine care). Postnatal mothers.	2-week RCT	Chamomile tea	Instructed to drink one cup of German chamomile tea daily for a period of 2 weeks. Prepared by seeping one teabag containing 2g dried flowers in 300ml hot water for 14-15 minutes daily	14-item Postpartum Sleep Quality Scale. Asked to record the incidence of sleep problems	The experimental group had significantly lower scores of physical-symptoms-related sleep inefficiency compared with the control (P = 0·015)	4

Chen & Chen Taiwan [45]	n=40 experimental and n=40 in control group (routine care). Postnatal mothers. Postnatal mothers	2-week RCT	Lavender tea.	Instructed to drink one cup of lavender tea daily after spending time to appreciate and smell the aroma	14-item Postpartum Sleep Quality Scale	The experimental group participants perceived less fatigue (P = .014) and depression (P = .033) and showed greater bonding with their infant (P = .049) compared with the control group	4
Ngan & Conduit, Australia [46]	n=41 (18-35 years)	7-day DB PC repeated-measures design	Passionflower tea	One cup of the tea daily	Sleep diary for 7-days. Spielberger state-trait anxiety inventory	Of six sleep-diary measures analysed, sleep quality was significantly better rated for passionflower compared with placebo (P< 0.01)	3
Rogers, et al. UK [42]	n=17 LTW, n=17 ONW sleep-restricted participants (20-34 years)	3-week trial	black tea and decaffeinated black tea	Provided with either decaffeinated tea and/or coffee for 3 weeks or regular tea and/or coffee for 3 weeks	Battery of tasks. Participants were sleep restricted	Acute caffeine withdrawal impaired cognitive performance, increased headache, and reduced alertness and clear-headedness	3
Hindmarch, et al. UK [43]	n=30 healthy participants	Randomised five-way crossover design	Black tea	1 or 2 cups of tea (containing 37.5 mg or 75 mg caffeine), or coffee (75 mg or 150 mg caffeine), or water. Drinks administered on four occasions during the day (0900, 1300, 1700 and 2300 hours)	Leeds Sleep Evaluation Questionnaire	Day-long tea consumption produced similar alerting effects to coffee, despite lower caffeine levels, but was less likely to disrupt sleep	3

Key: DB, Double-Blind; LCGT, Low-Caffeine Green Tea; LTW-Long-Term Caffeine Withdrawal; ONW-Overnight Caffeine Withdrawal; PC-Placebo Controlled; sAAm: Salivary A-Amylase Activity; SGT-Standard Green Tea. Slow wave sleep is also known as N3 sleep or delta sleep.

[38], validated sleep quality questionnaires or scales [43-45,47] and sleep diaries [46]. One study investigated the effects of decaffeinated or regular tea ingestion on participants that were sleep deprived [42]. Regarding study quality, the 10 human trials identified were of average or good quality, rating 3 or more on the Jadad quality index (Table 2), though it should be noted that methods of randomization and blinding were not always reported. It can, however, be difficult to 'blind' beverage trials, so most studies used regular drinking habits as a control or disseminated beverages in containers where the drink was not visible e.g., using covered metal containers.

Overall, the identified studies concluded that drinking tea and herbal infusions had beneficial or neutral effects on dimensions of sleep [38-41,43,44,46,47]. Focusing on oolong tea, research with non-obese males demonstrated that oolong tea (two 350 mL/day servings) increased fat oxidation by around 20% without impacting on sleep [39]. A trial conducted with children diagnosed with autism spectrum conditions showed that GABA delivery (in the form of oolong tea) could benefit anxiety levels and sensorimotor abilities, thus relaxing children which could aid sleep. [38].

Two studies undertaken by the same research team focused on green tea [40,41]. A double-blind crossover study with a sample of middle-aged adults (51.3 ± 6.7 years) found that sleep quality (included light sleep, slow wave sleep and onset of sleep) determined using EEG was improved and higher amongst participants ingesting larger amounts of low-caffeine green tea (≈300 ml daily eluted with water) [40]. Another study with older participants (89.3 ± 4.2 years) ingesting five cups of standard or low-caffeine green tea daily showed that low-caffeine green tea could aid sleep quality (included light sleep, slow-wave sleep, sleep onset and total sleep time), potentially by modifying stress as levels of Salivary α-amylase activity (sAA) were reduced and lower sAA correlated with higher sleep quality [41].

A further two studies focused on regular black tea [42,43]. Rogers, et al. (2005) studied the effects of caffeine consumption in sleep-restricted participants [42]. Subjects who were moderate to moderate–high caffeine consumers were provided with: 1) decaffeinated tea and/or coffee for 3 weeks or 2) regular tea and/or coffee for 3 weeks and after overnight caffeine abstinence were evaluated for mood and cognitive performance [42]. It was concluded that cognitive performance was adversely impacted by acute caffeine withdrawal aligning with the 'withdrawal reversal hypothesis' [42]. No conclusions were drawn that related specifically to tea [42]. Hindmarch, et al. asked 30 healthy participants to drink either: 1) 1 or 2 cups of tea (37.5 mg or 75 mg caffeine), 2) coffee (75 mg or 150 mg caffeine), or water [43]. Researchers found that day-long tea consumption produced alerting effects similar to coffee but were not as likely to disrupt sleep, measured using the Leeds Sleep Evaluation questionnaire daily and a wrist actigraph [43].

Other publications focused on infusions which included German Chamomile [44], Lavender [45] and Passionflower tea [46]. Two of these conducted research with mothers after they had given birth [44,45]. Chang & Chen (2016) recruited 80 postnatal mothers and allocated 40 of these to drink one cup of German Chamomile tea

Table 2: Phase 2: Tea Infusions, Psychological Stress, Anxiety and Sleep Health: Evidence from Mechanistic Studies.

Study (Author, Year, Reference Number)	Tea Intervention (type)	Main findings
Forouzanfar, et al. [63]	Green tea	Green tea and its EGCG appeared to prevent memory impairments during 6 h of total sleep deprivation.
Zhang, et al. [53]	L-theanine and Neumentix mixture	The L-THE/PSE mixture regulated sleep disorders by the GABA receptor and neurotransmitter systems.
Zhang, et al. [65]	Jasmine tea	Jasmine tea could attenuate mild stress/depression in rats via the brain- gut-microbiome axis.
Chaves, et al. [66]	Chamomile tea	4-O-methyl-glucuronoxylan in chamomile tea may contribute to the calming effects obtained by chamomile tea ingestion.
Yang, et al. [54]	Tea polyphenols	Increased TNFα in tea polyphenols ameliorated memory impairment caused by sleep deprivation
Kim, et al. [56]	GABA/l-theanine mixture	The mixture had a positive synergistic effect on sleep duration & quality. Increased GABA receptor & GluN1 expression was attributed to the neuromodulatory properties affecting sleep behaviour.
Unno, et al. [31]	Matcha green tea	High levels of theanine and arginine in matcha exhibited a high stress-reducing effect. This outcome was only possible when the molar ratio of caffeine and epigallocatechin gallate to theanine and arginine was less than two.
Ikram, et al. [59]	Green tea	The beneficial effects of green tea and coping with stressful conditions/stimuli are related to altered 5-Hydroxy tryptamine metabolism.
Unno, et al. [61]	Green tea	Drinking green tea resulted in anti-stress effects, where theanine, EGCG and Arg appear to induce effects.
Ferlemi, et al. [74]	Rosemary tea	Rosemary tea administration exerts anxiolytic and antidepressant effects on mice potentially by inhibiting liver cholinesterase activity.
Zhao, et al. [57]	GABA black tea	GABA black tea improved the sleeping quality (sleep time and sleep rate) of mice.
Mirza, et al. [61]	Green tea	Beneficial effects of green tea drinking may be due to alterations in serotonin and/or dopamine metabolism.
Burckhardt, et al. [55]	Green tea catechin polyphenols	Green tea–derived polyphenols reduced the neural susceptibility to intermittent hypoxia during sleep in rodents.
Adachi, et al. [62]	Epigallocatechin gallate	EGCG had sedative and hypnotic effects in the brain, partially through GABA receptors.
Vignes, et al. [64]	Epigallocatechin gallate	EGCG may induce anxiolytic activity which could result from an interaction with GABA(A) receptors.
Hossain, et al. [58]	Oolong tea	Fragrant compounds may be absorbed by the brain potentiating the GABA receptor response having a tranquillizing effect on the brain.

Key: Arg, arginine; EGCG (-)-Epigallocatechin gallate; GABA, gamma (γ)-aminobutyric acid; L-THE, L-theanine; PSE-Neumentix proprietary spearmint extract; TNF-tumour necrosis factor.

daily for two weeks [44]. Compared with the control group, the Chamomile group had fewer symptoms related to sleep inefficiency [44]. Authors concluded that Chamomile tea could be a useful aid for sleep quality problems [44]. Using a similar sample population Chen & Chen (2015) similarly found that Lavender tea (aromatic inhalation and consumption) resulted in significantly less fatigue and improved child bonding when one cup was drank daily for 2 week [45]. An Australian study providing young adults (18 to 35 years) with one cup of Passionflower tea daily found that sleep quality was better rated over the 7-day consumption period [46]. Other research using a combination of three different herbal teas in an infusion (Astragali Radix, Angelicaegigantis Radix, and Zizyphi Fructus) showed that when this was consumed twice daily for 4 weeks sleep quality, determined using the Pittsburgh Sleep Quality Index significantly improved [47].

Mechanistic research

Specific components found in tea, including the amino acid L-theanine are thought to aid sleep quality and induce relaxing effects [48]. L-theanine is thought to modulate aspects of human brain function including increasing alpha frequency band activity, and relaxing the mind [49]. Some research has shown that L-theanine can counteract and partially reverse reductions in slow-wave sleep induced by caffeine [50]. Gamma (γ)-aminobutyric acid (GABA) and glutamate neurons located within the brain reticular core regulate cortical activity and behaviour across wake-sleep states [51,52].

Sixteen key mechanistic studies were found investigating links between tea and sleep (Table 2). Zhang, et al. (2021) reports that L-theanine can modulate sleep, potentially by acting on neurotransmitter systems including the brain GABA [53]. Two studies focused on the role (s) of polyphenols [54,55]. Yang and colleagues (2020) concluded that tea polyphenols (active compounds in green tea) reduced tumour necrosis factor alpha (TNF-α) by down regulating TNF-α Converting Enzyme (TACE) level which could potentially ameliorate memory impairment caused by sleep deprivation [54]. Burckhardt and authors (2008) showed that green tea catechin polyphenols reduced oxidative stress which could be linked to sleep-disordered breathing [55].

Two publications focused on the role (s) of GABA [56,57]. The study undertaken by Kim, et al. (2015) demonstrated that the GABA/L-theanine had positive and synergistic effects on sleep quality and duration [56]. Zhao and researchers (2015) found that GABA black tea improved murine sleeping [57]. One other study focused on oolong

tea [58]. It was found that the fragrant compounds present in this tea, once inhaled, improved sleeping duration potentially by inducing a sedating effect [58].

Four studies investigated green tea [31,59-61]. Unno, et al. (2018) studied match a green tea finding that theanine and arginine present in this appeared to induce a stress-lowering effect [31]. An earlier study by the same research team also found similar effects with green tea [60]. Ikram, et al. (2017) concluded that altered 5-hydroxytryptamine metabolism could be one mechanism behind green teas ability to facilitate coping with stressful situations [59]. Mizra, et al. (2013) further concluded that benefits of green tea drinking could be attributed to alterations in serotonin and dopamine metabolism [61]. Regarding epigallocatechin-3-gallate (EGCG-a compound abundantly found in green tea), Adachi, et al. (2006) observed that EGCG induced hypnotic and sedative effects on the brain, potentially by modifying GABA receptors [62]. Other work showed that EGCG, could attenuate memory impairments during 6-h of total sleep deprivation [63]. Similarly, Vignes. et al. (2006) reported that EGCG may induce anxiolytic activity which can be due to interactions with GABA receptors [64].

Other research has studied the role (s) of other tea forms including Jasmine (green tea scented with jasmine flowers) and Chamomile tea [65,66]. Jasmine tea has been proposed to lower stress levels, potentially *via* the actions of the brain-gut microbiome axis which could potentially also aid sleep [65]. Chaves, et al. (2020) found that chamomile tea had calming effects with this appearing to be induced by 4-0-methyl-glucuronoxylan (a hemicellulosic plant cell wall) present in chamomile tea [66]. These mechanisms also have scope to facilitate sleep. Ongoing research is now needed.

Discussion

Tea and herbal infusions could be beneficial in certain areas of preventative health [26]. Polyphenols are chief active compounds present in teas and include catechins epigallocatechin-3-gallate, epigallocatechin, epicatechin-3-gallate, epicatechin amongst others [67]. Oolong tea (semi-aerated/fermented), a traditional Chinese tea also provides polyphenols including epigallocatechine-3-gallate, higher molecular weight flavonoids, polysaccharides and alkaloids [68,69]. Mechanistic studies show that Gamma (γ)-aminobutyric acid, present in black and oolong tea may exert effects that prolong sleep time [53,57,58]. In Chamomile tea (*Matricaria recutita L.*) its flower components provide phenols including the flavonoids apigenin, glucosides, patuletin, quercetin and luteolin possessing some antioxidant and antimicrobial properties [70]. Passiflora incarnata (Passion flower tea) is often used in traditional herbal medicine for insomnia in Europe, and in North American has been suggested as a sedative tea [71,72]. The plant has a complex Phytochemistry with only a portion of the pharmacologically active compounds believed to have been identified [71].

The present systematic review shows that a growing number of human trials, including RCTs and mechanistic studies have investigated tea and herbal infusions in relation to dimensions of psychological stress, anxiety, and sleep. As aforementioned good sleep is central to health and wellbeing [7,8]. From the human trials identified, eight (total sample size n=192) concluded that the ingestion of tea infusions improved aspects of sleep [38-41,44-47]. The quality of most studies was 'average', as identified using the Jadad scale. There is scope to undertake future studies controlling rigorously for blinding and clearly reporting randomisation methods.

In terms of study populations one study was conducted with children with autism spectrum conditions, suggesting that oolong tea could have relaxing benefits [38]. Two studies were carried out with adult mothers who had recently given birth who were experiencing broken sleep [44,45]. One trial administered oolong tea to obese males, implying benefits for fat oxidation without affecting sleeping patterns [39]. Another recruited the 'very old' (mean age 89.3 years) finding that green tea consumption lowered salivary α-amylase activity (a marker of stress) and improved sleep parameters [41]. These findings indicate that tea infusions may potentially benefit sleep health. It would now be useful to build on this research.

Regarding frequency of tea consumption, some studies showed sleep improvements at relatively low levels of ingestion (one to two cups daily) [39,44-47]. Provisional findings suggest that tea infusion consumption could form a promising part of sleep management strategies. Of the herbal infusions, German Chamomile, Lavender, Rose, Jasmine, and Passion flower appear to be most promising as sleep health aids. In research using Lavender tea with sleep-deprived mothers, it was the consumption alongside the 'inhalation' of the aroma that was associated with less fatigue [45]. A separate survey of 1,000 adults in the UK (aged 18 to 60 years) reviewed by the Tea Advisory Panel has shown that when drinking tea, 57% of felt relaxed, one in two felt calm and 34% felt ready for their next task [73]. Similarly, 4 in 10 (42%) reported that regular tea drinking helped with stress and anxiety, 23% found that it helped with low mood and 22% reported increased mental alertness [74]. Taken together, these findings suggest that it is the psychological and 'calming' effects of tea that could help to aid relaxation.

Conclusions and Future Prospects

In conclusion, good sleep is a central part of good health. Alongside focusing on other aspects of health, the importance of lowering psychological stress, anxiety and promoting good sleep health should additionally be communicated to all. The present review demonstrates that evidence for German Chamomile, Lavender, Rose, Jasmine, and Passionflower tea looks promising. The ingestion of green, oolong and black tea, and the inhalation of their aromas could also potentially help to aid sleep, possibly due to relaxing effects. Tea and herbal infusions can be easily integrated within habitual diets and lifestyles and could be a viable means of aiding relaxation and sleep. Research also can inform consumer choice for particular end points e.g., tea drinking provides similar mental alertness *versus* coffee consumption but with no impacts on sleep. It should be considered, however, that variability in samples, small sample sizes and use of different sleep measures in studies means that ongoing research is needed to further verify effects.

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References

1. Lu S, Wei F, Li G (2021) The evolution of the concept of stress and the framework of the stress system. Cell Stress 5: 76-85.
2. Anxiety.Org. What is anxiety?

3. Kalmbach DA, Anderson JR, Drake CL (2018) The impact of stress on sleep: Pathogenic sleep reactivity as a vulnerability to insomnia and circadian disorders. J Sleep Res 27: e12710.

4. Pires GN, Bezerra AG, Tufik S, Andersen ML (2016) Effects of acute sleep deprivation on state anxiety levels: a systematic review and meta-analysis. Sleep Med 24: 109-118.

5. Stanton R, To QG, Khalesi S, Williams SL, Alley SJ, et al. (2020) Depression, Anxiety and Stress during COVID-19: Associations with Changes in Physical Activity, Sleep, Tobacco and Alcohol Use in Australian Adults. Int J Environ Res Public Health 17: 4065.

6. Buysse DJ (2014) Sleep health: can we define it? Does it matter? Sleep 37: 9-17.

7. Grandner MA (2020) Sleep, Health, and Society. Sleep Med Clin 15: 319-340.

8. Irwin MR (2015) Why sleep is important for health: a psychoneuroimmunology perspective. Annu Rev Psychol 66: 143-172.

9. Watson NF, Badr MS, Belenky G, Bliwise DL, Buxton OM, et al. (2015) Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society on the Recommended Amount of Sleep for a Healthy Adult: Methodology and Discussion. Sleep 38: 1161-1183.

10. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, et al. (2015) National Sleep Foundation's sleep time duration recommendations: methodology and results summary. Sleep Health 1: 40-43.

11. Kocevska D, Lysen TS, Dotinga A, Verhoeff MEK, Luijk MPCM, et al. (2021) Sleep characteristics across the lifespan in 1.1 million people from the Netherlands, United Kingdom and United States: a systematic review and meta-analysis. Nat Hum Behav 5: 113-122.

12. Zhu G, Catt M, Cassidy S, Machin MB, Trenell M, et al. (2019) Objective sleep assessment in >80,000 UK mid-life adults: Associations with sociodemographic characteristics, physical activity and caffeine. PLoS One 14: e0226220.

13. Wong TY, Travis RC, Tong TYN (2021) Blood biomarker levels by total sleep duration: cross-sectional analyses in UK Biobank. Sleep Med 88: 256-261.

14. Naiman R (2017) Dreamless: the silent epidemic of REM sleep loss. Ann N Y Acad Sci 1406: 77-85.

15. Troynikov O, Watson CG, Nawaz N (2018) Sleep environments and sleep physiology: A review. J Therm Biol 78: 192-203.

16. Lewis LD (2021) The interconnected causes and consequences of sleep in the brain. Science 374: 564-568.

17. Plante DT (2021) The Evolving Nexus of Sleep and Depression. Am J Psychiatry 178: 896-902.

18. Scott AJ, Webb TL, James MM, Rowse G, Weich S (2021) Improving sleep quality leads to better mental health: A meta-analysis of randomised controlled trials. Sleep Med Rev 60: 101556.

19. Li J, Cao D, Huang Y, Chen Z, Wang R, et al. (2022) Sleep duration and health outcomes: an umbrella review. Sleep Breath 26: 1479-1501.

20. Primack C (2021) Obesity and Sleep. Nurs Clin North Am 56: 565-572.

21. Walsh NP, Halson SL, Sargent C, Roach GD, Nédélec M, et al. (2020) Sleep and the athlete: narrative review and 2021 expert consensus recommendations. Br J Sports Med 102025.

22. Robinson CH, Albury C, McCartney D, Fletcher B, Roberts N, et al. (2021) The relationship between duration and quality of sleep and upper respiratory tract infections: a systematic review. Fam Pract 38: 802-810.

23. Sieck GC (2021) Physiology in Perspective: Eat, Sleep, Survive-Natural Cycle of Life. Physiology (Bethesda) 36: 201-202.

24. Li X, Lyu J, Guo Y, Bian Z, Yu C, et al. (2015) [Regional differences in adults' tea drinking pattern: findings from China Kadoorie Biobank study in 10 areas in China]. Zhonghua Liu Xing Bing Xue Za Zhi 36: 1195-1199.

25. Landais E, Moskal A, Mullee A, Nicolas G, Gunter MJ, et al. (2018) Coffee and Tea Consumption and the Contribution of Their Added Ingredients to Total Energy and Nutrient Intakes in 10 European Countries: Benchmark Data from the Late 1990s. Nutrients 10: 725.

26. Poswal FS, Russell G, Mackonochie M, MacLennan E, Adukwu EC, et al. (2019) Herbal Teas and their Health Benefits: A Scoping Review. Plant Foods Hum Nutr 74: 266-276.

27. Pan SY, Nie Q, Tai HC, Song XL, Tong YF, et al. (2022) Tea and tea drinking: China's outstanding contributions to the mankind. Chin Med 17: 27.

28. Etheridge CJ, Derbyshire E (2020) Herbal infusions and health: A review of findings from human studies, mechanisms and future research directions. Nutrition & Food Science 50: 969-985.

29. Sakamoto FL, Ribeiro RMP, Bueno AA, Santos HO (2019) Psychotropic effects of L-theanine and its clinical properties: From the management of anxiety and stress to a potential use in schizophrenia. Pharmacol Res 147: 104395.

30. Brown D (2020) A Review of the PubMed PICO Tool: Using Evidence-Based Practice in Health Education. Health Promot Pract 21: 496-498.

31. Unno K, Furushima D, Hamamoto S, Iguchi K, Yamada H, et al. (2018) Stress-Reducing Function of Matcha Green Tea in Animal Experiments and Clinical Trials. Nutrients 10: 1468.

32. Yoto A, Murao S, Nakamura Y, Yokogoshi H (2014) Intake of green tea inhibited increase of salivary chromogranin A after mental task stress loads. J Physiol Anthropol 33: 20.

33. Bazrafshan MR, Jokar M, Shokrpour N, Delam H (2020) The effect of lavender herbal tea on the anxiety and depression of the elderly: A randomized clinical trial. Complement Ther Med 50: 102393.

34. Tseng YF, Chen CH, Yang YH (2005) Rose tea for relief of primary dysmenorrhea in adolescents: a randomized controlled trial in Taiwan. J Midwifery Womens Health 50: e51-57.

35. Yoto A, Fukui N, Kaneda C, Torita S, Goto K, et al. (2018) Black tea aroma inhibited increase of salivary chromogranin-A after arithmetic tasks. J Physiol Anthropol 37: 3.

36. Samant SS, Wilkes K, Odek Z, Seo HS (2016) Tea-induced calmness: Sugar-sweetened tea calms consumers exposed to acute stressor. Sci Rep 6: 36537.

37. Steptoe A, Gibson EL, Vuononvirta R, Williams ED, Hamer M, et al. (2007) The effects of tea on psychophysiological stress responsivity and post-stress recovery: a randomised double-blind trial. Psychopharmacology (Berl) 190: 81-89.

38. Hannant P, Cassidy S, Renshaw D, Joyce A (2021) A double-blind, placebo-controlled, randomised-designed GABA tea study in children diagnosed with autism spectrum conditions: a feasibility study clinical trial registration: ISRCTN 72571312. Nutr Neurosci 24: 45-61.

39. Zhang S, Takano J, Murayama N, Tominaga M, Abe T, et al.(2020) Subacute Ingestion of Caffeine and Oolong Tea Increases Fat Oxidation without Affecting Energy Expenditure and Sleep Architecture: A Randomized, Placebo-Controlled, Double-Blinded Cross-Over Trial. Nutrients 12: 3671.

40. Unno K, Noda S, Kawasaki Y, Yamada H, Morita A, et al. (2017) Reduced Stress and Improved Sleep Quality Caused by Green Tea Are Associated with a Reduced Caffeine Content. Nutrients 9: 777.

41. Unno K, Noda S, Kawasaki Y, Yamada H, Morita A, et al. (2017) Ingestion of green tea with lowered caffeine improves sleep quality of the elderly *via* suppression of stress. J Clin Biochem Nutr 61: 210-216.

42. Rogers PJ, Heatherley SV, Hayward RC, Seers HE, Hill J, et al. (2005) Effects of caffeine and caffeine withdrawal on mood and cognitive performance degraded by sleep restriction. Psychopharmacology (Berl) 179: 742-752.

43. Hindmarch I, Rigney U, Stanley N, Quinlan P, Rycroft J, et al. (2000) A naturalistic investigation of the effects of day-long consumption of tea, coffee and water on alertness, sleep onset and sleep quality. Psychopharmacology (Berl) 149: 203-216.

44. Chang SM, Chen CH (2016) Effects of an intervention with drinking chamomile tea on sleep quality and depression in sleep disturbed postnatal women: a randomized controlled trial. J Adv Nurs 72: 306-315.

45. Chen SL, Chen CH (2015) Effects of Lavender Tea on Fatigue, Depression, and Maternal-Infant Attachment in Sleep-Disturbed Postnatal Women. Worldviews Evid Based Nurs 12: 370-379.

46. Ngan A, Conduit R (2011) A double-blind, placebo-controlled investigation of the effects of Passiflora incarnata (passionflower) herbal tea on subjective sleep quality. Phytother Res 25: 1153-1159.

47. Baek Y, Kim H, Mun S, Lee S (2018) Three-Component Herbal Tea Alleviates Prolonged Fatigue and Improves Sleep Quality: A Randomized Controlled Pilot Study. Explore (NY) 14: 420-423.

48. Türközü D, Nevin Şanlier (2017) L-theanine, unique amino acid of tea, and its metabolism, health effects, and safety. Crit Rev Food Sci Nutr 57: 1681-1687.

49. Nobre AC, Rao A, Owen GN (2008) L-theanine, a natural constituent in tea, and its effect on mental state. Asia Pac J Clin Nutr 17: 167-168.

50. Jang HS, Jung JY, Jang IS, Jang KH, Kim SH, et al. (2012) L-theanine partially counteracts caffeine-induced sleep disturbances in rats. Pharmacol Biochem Behav 101: 217-221.

51. Jones BE (2020) Arousal and sleep circuits. Neuropsychopharmacology 45: 6-20.

52. Schneider L (2020) Neurobiology and Neuroprotective Benefits of Sleep. Continuum (Minneap Minn) 26: 848-870.

53. Zhang Y, Jia X, Chen X, Liu Y, Zhao Z, et al. (2021) L-theanine and Neumentix mixture improves sleep quality and modulates brain neurotransmitter levels in mice. Ann Palliat Med 10: 4572-4581.

54. Yang H, Xie J, Mu W, Ruan X, Zhang J, et al. (2020) Tea polyphenols protect learning and memory in sleep-deprived mice by promoting AMPA receptor internalization. Neuroreport 31: 857-864.

55. Burckhardt IC, Gozal D, Dayyat E, Cheng Y, Li RC, et al. (2008) Green tea catechin polyphenols attenuate behavioral and oxidative responses to intermittent hypoxia. Am J Respir Crit Care Med 177: 1135-1141.

56. Kim S, Jo K, Hong KB, Han SH, Suh HJ, et al. (2019) GABA and l-theanine mixture decreases sleep latency and improves NREM sleep. Pharm Biol 57: 65-73.

57. Zhao W, Li Y, Ma W, Ge Y, Huang Y (2015) A study on quality components and sleep-promoting effects of GABA black tea. Food Funct 6: 3393-3398.

58. Hossain SJ, Aoshima H, Koda H, Kiso Y (2004) Fragrances in oolong tea that enhance the response of GABAA receptors. Biosci Biotechnol Biochem 68: 1842-1848.

59. Ikram H, Mirza B, Haleem DJ (2017) Neurochemical and behavioral effects of green tea (Camellia sinensis) as observed in animals exposed to restraint stress. Pak J Pharm Sci 30: 487-492.

60. Unno K, Hara A, Nakagawa A, Iguchi K, Ohshio M, et al. (2016) Anti-stress effects of drinking green tea with lowered caffeine and enriched theanine, epigallocatechin and arginine on psychosocial stress induced adrenal hypertrophy in mice. Phytomedicine 23: 1365-1374.

61. Mirza B, Ikram H, Bilgrami S, Haleem DJ, Haleem MA (2013) Neurochemical and behavioral effects of green tea (Camellia sinensis): a model study. Pak J Pharm Sci 26: 511-516.

62. Adachi N, Tomonaga S, Tachibana T, Denbow DM, Furuse M (2006) (-)-Epigallocatechin gallate attenuates acute stress responses through GABAergic system in the brain. Eur J Pharmacol 531: 171-175.

63. Forouzanfar F, Gholami J, Foroughnia M, Payvar B, Nemati S, et al. (2021) The beneficial effects of green tea on sleep deprivation-induced cognitive deficits in rats: the involvement of hippocampal antioxidant defense. Heliyon 7: e08336.

64. Vignes M, Maurice T, Lanté F, Nedjar M, Thethi K, et al. (2006) Anxiolytic properties of green tea polyphenol (-)-epigallocatechin gallate (EGCG). Brain Res 1110: 102-115.

65. Zhang Y, Huang J, Xiong Y, Zhang X, Lin Y, et al. (2021) Jasmine Tea Attenuates Chronic Unpredictable Mild Stress-Induced Depressive-like Behavior in Rats *via* the Gut-Brain Axis. Nutrients 14: 99.

66. Chaves PFP, Hocayen PDAS, Dallazen JL, Werner MFDP, Iacomini M, et al. (2020) Chamomile tea: Source of a glucuronoxylan with antinociceptive, sedative and anxiolytic-like effects. Int J Biol Macromol 164: 1675-1682.

67. Khan N, Mukhtar H (2018) Tea Polyphenols in Promotion of Human Health. Nutrients 11: 39.

68. Ng KW, Cao ZJ, Chen HB, Zhao ZZ, Zhu L, et al. (2018) Oolong tea: A critical review of processing methods, chemical composition, health effects, and risk. Crit Rev Food Sci Nutr 58: 2957-2980.

69. Cao H (2013) Polysaccharides from Chinese tea: recent advance on bioactivity and function. Int J Biol Macromol 62: 76-79.

70. McKay DL, Blumberg JB (2006) A review of the bioactivity and potential health benefits of chamomile tea (Matricaria recutita L.). Phytother Res 20: 519-530.

71. Miroddi M, Calapai G, Navarra M, Minciullo PL, Gangemi S (2013) Passiflora incarnata L.: ethnopharmacology, clinical application, safety and evaluation of clinical trials. J Ethnopharmacol 150: 791-804.

72. Kim M, Lim HS, Lee HH, Kim TH (2017) Role Identification of Passiflora Incarnata Linnaeus: A Mini Review. J Menopausal Med 23: 156-159.

73. PG. Perspectus Global. Patterna of Tea Drinking.

74. Ferlemi AV, Katsikoudi A, Kontogianni VG, Kellici TF, Iatrou G, et al. (2015) Rosemary tea consumption results to anxiolytic- and anti-depressant-like behavior of adult male mice and inhibits all cerebral area and liver cholinesterase activity; phytochemical investigation and in silico studies. Chem Biol Interact 237: 47-57.