Istanbul J Pharm 53 (2): 118-125
DOI: 10.26650/IstanbulJPharm.2023.1256243
**Original Article**

# Comparing the effects of aromatherapy and mindfulness meditation on university students' stress levels

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**Cite this article as:** Ozdemir Nath, E., & Kucukarslan, G.N. (2023). Comparing the effects of aromatherapy and mindfulness meditation on university students' stress levels. *Istanbul Journal of Pharmacy, 53*(2), 118-125. DOI: 10.26650/IstanbuJPharm.2023.1256243

**ABSTRACT**

**Background and Aims:** Aromatherapy is the combination of aroma and therapy and literally means treatment with fragrance. Massage, inhalation, compresses, and baths are the most common applications of aromatherapy. According to several studies, inhalation of essential oils greatly reduces anxiety and tension. On the other hand, the last 30 years has seen an increase in the popularity of mindfulness meditation for reducing the risk of depressive relapse while also lowering stress and anxiety levels. The aim of this study is to compare the effects of aromatherapy and mindfulness practices on university students' stress levels.

**Methods:** A total of 78 Altınbaş University students participated in this study, which uses the Beck Depression Inventory-II and Perceived Stress Scale to collect data. Five experimental groups were created in which aromatherapy and mindfulness meditation studies were applied, with a control group also used in an experimental investigation that includes pretest and posttest assessments. *Cedrus atlantica* (Endl.) G.Manetti ex Carrière (CA) and *Cananga odorata* (Lam.) Hook.f. & Thomson (CO) essential oils were used in the aromatherapy applications.

**Results:** As a result, this study has found the participants' anxiety levels to decrease, with all intervention groups having lower posttest scores than their pretest levels.

**Conclusion:** The results of this study show a decrease in post-intervention test scores for all experimental groups compared to the control group, particularly for the groups where aromatherapy and mindfulness meditation were administered together. Aromatherapy and mindfulness emerge as viable therapeutic options for anxiety, with CA and CO essential oils being particularly useful.

**Keywords:** Aromatherapy, Cananga odorata, Cedrus atlantica, essential oils, mindfulness meditation

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Submitted: 24.02.2023
Revision Requested: 08.05.2023
Last Revision Received: 31.05.2023
Accepted: 12.06.2023
Published Online: 28.08.2023

## INTRODUCTION

Aromatherapy is a term that combines the phrases scent and therapy. Aroma as a term has a variety of meanings, such as sweet perfume and spice in Latin, as well as spice in Greek. Therapy comes from the Greek *therapeia*, which means cure/healing. Purists believe that the term aromatherapy should only be used to refer to the use of essential oils in ways that are consistent with its definition, such as inhalation as opposed to massage or other application techniques (Price & Price, 2011). Essential oil analysis has become increasingly popular in recent years. Essential oils are secondary metabolites generated by aromatic plants. They are volatile, natural, complex compounds with a strong odor (Lucchesi, Chemat, & Smadja, 2004; Shaw, 1979). The use of essential oils to promote relaxation has become commonplace, with the calming effects of lavender, cedarwood, and vetiver making them effective for treating anxiety and sadness. Aromatherapy is frequently used topically and during massage (Suyono et al., 2020).

*Cedrus atlantica* (cedarwood) essential oil includes hydrocarbons (sesquiterpenes such as β-himachalene at 30.8–40.4%, α-himachalene at 10.3–16.4%, and γ-himachalene at 6.7–9.7%), alcohols (sesquiterpenols such as epi-β-cubenol at 1.1–2.5%), and ketones (sesquiterpenones such as α-atlantone at 5.2–13.4% and γ-atlantone at 1.2–3.9%; Price & Price, 2011; Tisserand & Young, 2013). The antispasmodic, astringent, decongestant, insecticide, sedative, and soothing properties of cedarwood essential oil have all been utilized. According to Suyono et al (2020), rats exposed to stress from extended swimming had their plasma cortisol levels decreased using *Cedrus* essential oil balms. The amount of cortisol is reduced more effectively when a higher quantity of essential oils is applied. *Cedrus* essential oil's 30% concentration produces a diazepam-like action (Suyono, Jong, & Wijaya, 2020). One study investigated the effect of textile products produced with essential oils on stress . The 20 female participants reported feeling less stressed after using the aroma-therapeutic textiles created for their study. Their findings suggested that inhaling the lavender and cedarwood aroma-therapeutic textiles to have significantly reduced stress in the individuals compared to the control textile. A statistically significant reduction in skin conductance, respiration rate, and heart rate (PNS activity) was also observed when using the aroma-therapeutic textiles compared to the aroma-less control textile (Mehta & MacGillivray, 2016).

*Cananga odorata* (CO; ylang-ylang) essential oil includes hydrocarbons (sesquiterpenes such as β-caryophyllene at 38.2%, α-caryophyllene at 9.2%, germacrene D at 8.3%, and δ-cadinene at 6.0%) and alcohols (monoterpenols such as linalool at 5.6%). CO essential oil was also recorded to have antidiabetic, antiseptic, antispasmodic, balancing, calming, hypotensor, tonic, reproductive stimulant, and sedative properties (Price & Price, 2011; Tisserand & Young, 2013). According to Hongratanaworakit and Buchbauer , CO as an essential oil has calming effects and offers some support when used together with medicines to lower blood pressure or treat depression and stress in people(Hongratanaworakit & Buchbauer, 2006). Exposure to the smell of CO may be able to counteract the anxiety-inducing effects of piperazine (m-CPP). The extracellular signal-regulated kinase 1/2 (ERK1/2) and cAMP response element-binding protein (CREB) pathway in the hippocampus and the serotonin system were found to both be involved in the anxiolytic effects of CO essential oil (Zhang, Zhang, Feng, & Yao, 2018).

Mindfulness meditation refers to a subset of meditation techniques known as mindfulness meditation. Mindfulness meditations such as Zen/Chan and Vipassana are common (Jalali-Heravi, Parastar, & Sereshti, 2010). Dr. Kabat-Zinn introduced mindfulness-based stress reduction into psychotherapy in the late 1970s to assist patients in managing stress, pain, mood, and comfort in life (Kabat-Zinn, 1982). Individuals who are experiencing unpleasant emotions or difficult life circumstances such as stress, depression, anxiety, or fear can learn to stop so-called action mode (i.e., automatic, unconscious, habitual reaction mode) by using mindfulness treatment. Mindfulness-based stress reduction (MBSR) is well acknowledged to have a positive effect on young people's ability to regulate their emotions and has been attracting ever greater attention. Medical students and young children who participate in MBSR interventions can successfully lower their self-reported trait and status anxiety and improve their mental experience score measured at the end of an intervention (Shapiro, Schwartz, & Bonner, 1998). Mindfulness meditation entails establishing a unique mental characteristic known as mindfulness. When adopting an attitude of curiosity, openness, and acceptance, awareness then entails self-regulation of attention to conscious awareness of one's current experiences (Shapiro, Astin, Bishop, & Cordova, 2005). Zhou et al. (2020) chose 1,489 people from 14 studies for comparison with the controls, and their meta-analysis concluded MBSR to considerably reduced anxiety symptoms (Zhou et al., 2020).

Long-term stress is harmful to one's health. The hypothalamic-pituitary-adrenal axis is activated by stress, which raises the level of the corticosteroid hormone. Cortisol overproduction impairs metabolism, disturbs sleep, and suppresses the immune system. Exams, too many courses, and challenging living situations increase the stress levels of university students during their student years. A person experiences stress when they encounter a situation that is hard to adapt to. Stress is a state of physiological, mental, and physical stress and is an unusual physiological response that occurs in the body in response to imaginary or real harm and a variety of stimuli (Schneiderman, Ironson, & Siegel, 2005). Job stress has also been shown to emerge when an imbalance occurs between the demands of the workplace and the resources, abilities, or needs of employees (Chen et al., 2017).

## MATERIALS AND METHODS

### Essential oil material

*CO* and *Cedrus atlantica* (CA) essential oils have been widely recommended by pharmacists and used through inhalation to reduce stress and anxiety problems in Türkiye, which is why this study has chosen to apply CO and CA oils. The study only used essential oils sold in pharmacies in Türkiye.

**Determining the composition of the essential oils**

Gas chromatography with flame ionization detection (GC-FID) and with mass spectrometry (GC-MS) were used to test 10% (v/v) solutions of essential oil in n-hexane. The identification and quantification of the constituents of essential oils were made possible by an Agilent 7890B GC-FID (Santa Clara, CA, USA) connected to an Agilent 5977E electron impact mass spectrometer (Santa Clara, CA, USA) via a two-way capillary splitter. 1 mL of the sample solutions was injected using an Agilent G4513A auto injector (Santa Clara, CA, USA). The DB WAX column (60 m, 0.25 mm, 0.25 µm) was run on the following temperature program: 70 $^0$C for 15 minutes, then 180 $^0$C at an increase rate of 2$^0$C/min. After maintaining an isothermal temperature of 180 °C for 5 minutes, the column temperature was raised to 230 °C at a rate of 5°C/min. The final isothermal column temperature was set at 230°C for 15 minutes. The analysis was allowed 100 minutes. Helium was used as a carrier gas at a constant flow rate of 1.5 mL/min. The split ratio was set at 1:50. The mass detector scan range was 45-450 m/z. The chemicals were identified by matching the mass spectra of the substances included in the Wiley Registry of Mass Spectral Data (9$^{th}$ ed.; April 2011) with those found in the National Institute of Standards and Technology (NIST) 11 Mass Spectral Library (NIST11/2011/EPA/NIH), as well as by using real reference samples. Calculated retention indices from the co-injected saturated alkane series (C7-C40) were then used to compare the findings to earlier research and the NIST online webbook. Using calibration curves made by performing GC-FID tests on the sample chemicals, quantification was carried out using an external standard method, with three different analyses being carried out for each. This part of the analyses was conducted in the BITEM-Bezmialem University- Phytotherapy Education, Research and Application Center.

**Study design and sample**

A total of 78 Altınbaş University students aged 18-29 years old participated in this study. Six groups of voluntary students were selected at random. Each group had 13 participants (2 males and 11 females), and the six groups were comprised of Group 1 (G1) who used CO essential oil inhalation, Group 2 (G2) who used CA essential oil inhalation, Group 3 (G3) who used CO essential oil inhalation and practiced the mindfulness meditation program, Group 4 (G4) who used CA essential oil inhalation and practiced the mindfulness meditation program, Group 5 (G5) who practiced mindfulness meditation, and a wait-list control group (WL) who did nothing (Fig. 1).

**Study procedure**

Over 15 days, each student did an intervention every night between 10:00-10:30 pm according to their group. The students in the aromatherapy groups students applied 1 drop of oil to their masks and put their mask on for 30 min. The students in the meditation group practiced mindfulness meditation by listening to pre-recorded audio for 30 min. The students in the aromatherapy and mindfulness meditation groups applied 1 drop of oil to their masks and put on their masks for 30 min. while practicing the mindfulness meditation based on the audio recording. The five experimental groups and control group were included in an experimental investigation with pretest and posttest assessments. The Beck Depression Inventory-II and Perceived Stress Scale were used to collect the data. The individuals were asked to respond to the health-related questions and provide demographic data. All subjects were required to have normal body mass index (BMI) readings and to be free of respiratory difficulties (e.g., asthma, cold, flu) or any other olfactory-related illnesses. After the formation of the control and intervention groups, the Beck Depression Inventory-II (BDI-II) and Perceived Stress Scale (PSS) were administered as a pretest and filled out by all participants in the conference hall of Altınbaş University in Istanbul's Bakırköy district. This occurred again after the study as the posttest. This study was approved by the Altınbaş University's Ethics Committee on January 20, 2022 (Approval No. 97).

**Instruments**

The 21-question multiple-choice BDI-II was created by Aaron T. Beck and is one of the most widely used psychometric measures for determining the severity of depression (Beck, Steer, Ball, & Ranieri, 1996). When it first emerged, mental health professionals who had up until that point considered of depression as being rooted in the patient's own thoughts undertook a paradigm shift. A well-known method for measuring stress is the 14-question PSS (Cohen, Kamarck, & Mermelstein, 1983). Despite being developed in 1983, the instrument is still a well-preferred choice for helping understand how diverse situations affect feelings and how people perceive stress. This scale asks about one's thoughts and feelings from the last month. It asks how frequently one has felt or thought about each emotion or topic.

**Data analysis**

When the entire intervention program finished, the BDI-II and PSS were administered as a posttest and filled by all participants. The investigation program's goals were explained to all

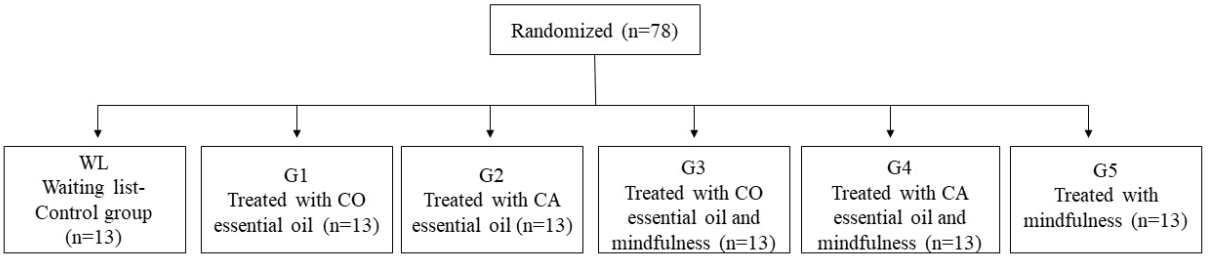


**Figure 1.** Study design.

participants. Prior to participating, they read and signed an informed consent form approved by Altınbaş University's Ethics Committee. The means and standard deviations were calculated. The differences according to the results were calculated and interpreted. The Wilcoxon test for paired samples was used to find significant differences between the research phases, and the Kruskal-Walls test was used to find differences between the WL group and the intervention groups. Percentages were calculated regarding the differences between the pretest and posttest results. SPSS (ver. 28 (IBM Corp., Armonk, NY, USA) was used for all statistical data analyses. Results with a 95% confidence level and $p < 0.05$ were deemed significant.

## RESULTS

### Essential oils composition

The findings from the GC-MS analysis of the samples are displayed in Tables 1 and 2. 93.90% of all the compounds in the *CO* essential oil were identified. The major compounds are germacrene-D (21.37%), linalool (14.45%), caryophyllene (E; 12.08%), geranyl acetate (11.10%), benzyl benzoate (7.31%), and farnesene (4.79%). 89.31% of all compounds in the *Cedrus atlantica* essential oil were identified. The major compounds are b- himachalene (49.81%), a-himachalene (18%), and longifolene (12.43%).

### Comparing the effects from the aromatherapy and mindfulness meditation

As a result, the article conducted a two-week study to determine the effects of aromatherapy and mindfulness meditation on the university students' stress levels. Their stress levels were examined before and after the two-week study and compared to the globally accepted BDI-II and PSS assessments. The effects from the aromatherapy and mindfulness meditation on the students' stress levels were calculated and obtained using comparative numerical data. Table 3 lists the sociodemographic and clinical information for the study's 12 male and 66 female participants. The participants are single undergraduate university students between the ages of 18-29. The BDI-II and PSS mean scores and SDs are shown in Table 4. The BDI-II posttest scores for the five experimental groups differ significantly from those of the WL group, although G1 did not differ

**Table 1. The essential oil compositions of *Cananga odorata*.**

| No. | Components | KI[a] | RRI[b] | Relative % | Identifaction Method |
|---|---|---|---|---|---|
| 1 | a-pinene | 1018-1032 | 1027 | 0.23 ± 0.01 | RRI, MS |
| 2 | p-methylanisole | 1434-1446 | 1440 | 4.28 ± 0.03 | RRI, MS |
| 3 | a-Copaene | 1481-1497 | 1488 | 0.65 ± 0.04 | RRI, MS |
| 4 | Linalool | 1537-1553 | 1522 | 14.45 ± 0.06 | RRI, MS |
| 5 | b-Elemene | 1585-1600 | 1588 | 0.31 ± 0.06 | RRI, MS |
| 6 | Caryophyllene (E) | 1585-1612 | 1593 | 12,08 ± 0.05 | RRI, MS |
| 7 | Methyl benzoate | 1600-1632 | 1621 | 2.47 ± 0.02 | RRI, MS |
| 8 | a-Humulene | 1655-1682 | 1664 | 3.46 ± 0.02 | RRI, MS |
| 9 | ɣ -Muurolene | 1679-1704 | 1684 | 0.64 ± 0.02 | RRI, MS |
| 10 | Bergamotene | 1547-1710 | 1696 | 1.06 ± 0.03 | RRI, MS |
| 11 | Germacrene-D | 1699-1726 | 1706 | 21.37 ± 0.18 | RRI, MS |
| 12 | a-Muurolene | 1714-1740 | 1720 | 0.33 ± 0.03 | RRI, MS |
| 13 | Benzyl acetate | 1697-1742 | 1729 | 3.20 ± 0.09 | RRI, MS |
| 14 | Farnesene -a-(E,E) | 1735-1755 | 1749 | 4.79 ± 0.05 | RRI, MS |
| 15 | ɣ-Cadinene | 1746-1772 | 1753 | 1.65 ± 0.03 | RRI, MS |
| 16 | Geranyl acetate | 1743-1764 | 1758 | 11.10 ± 0.03 | RRI, MS |
| 17 | Geraniol | 1830-1857 | 1846 | 2.26 ± 0.02 | RRI, MS |
| 18 | 3-methyl-2-butenyl benzoate | N/A | 2062 | 0.74 ± 0.02 | RRI, MS |
| 19 | Cinnamyl acetate | 2132-2167 | 2146 | 1.04 ± 0.01 | RRI, MS |
| 20 | Tau-Muurolol | 2169-2189 | 2179 | 0.34 ± 0.00 | RRI, MS |
| 21 | a-Cadinol | 2218-2255 | 2230 | 0.68 ± 0.03 | RRI, MS |
| 22 | Farnesyl acetate | 2222-2267 | 2264 | 1.06 ± 0.03 | RRI, MS |
| 23 | Farnesol | 2350-2367 | 2355 | 1.61 ± 0.04 | RRI, MS |
| 24 | Benzyl benzoate | 2577-2648 | 2633 | 7.31 ± 0.06 | RRI, MS |
| 25 | Benzyl salicylate | 2267-2796 | 2791 | 1.80 ±0.02 | RRI, MS |
| | Total identified | | | 98.92 | |

[a] These are found in the literature with 50% confidence intervals for the RI data ranges for each compound.
[b] Relative retention indices calculated against n-alkanes; % calculated from FID data. Identification method based on the relative retention indices (RRI) of compounds on the HP Innowax column; Mass spectrometer identification was performed on the basis of computer matching of the mass spectra with those of the Wiley and MassFinder libraries and compared with literature data.

**Table 2. The essential oil compositions of *Cedrus atlantica*.**

| No | Components | KI[a] | RRI[b] | Relative % | Identifaction Method |
|---|---|---|---|---|---|
| 1 | Limona ketone | 1550-1570 | 1552 | 0.35 ± 0.01 | RRI, MS |
| 2 | a-Himachalene | 1652-1670 | 1647 | 18.00 ± 0.15 | RRI, MS |
| 3 | Longifolene | 1694-1704 | 1697 | 12.43 ± 0.11 | RRI, MS |
| 4 | b- Himachalene | 1700-1721 | 1708 | 49.81 ± 0.20 | RRI, MS |
| 5 | ɣ-Cadinene | 1752–1776 | 1753 | 1.60 ± 0.02 | RRI, MS |
| 6 | a-Bisabolene | 1761-1784 | 1771 | 0.60 ± 0.04 | RRI, MS |
| 7 | Neoisolongifolene | 1808-1820 | 1817 | 1.02 ± 0.03 | RRI, MS |
| 8 | Isolongifolene | 1850-1913 | 1858 | 1.47 ± 0.02 | RRI, MS |
| 9 | 1-Acetonaphthone, 8-methoxy | N/A | 1894 | 1.38 ± 0.01 | RRI, MS |
| 10 | a-Calarone | 1912–1941 | 1916 | 0.77 ± 0.01 | RRI, MS |
| 11 | b- Himachaleneoxide | 2004-2045 | 2011 | 1.61 ± 0.02 | RRI, MS |
| 12 | Calarene epoxide | N/A | 2045 | 0.61 ± 0.01 | RRI, MS |
| 13 | 4-epi-Cubedol | 2050-2088 | 2060 | 0.54 ± 0.02 | RRI, MS |
| 14 | Spathulenol | 2074–2150 | 2079 | 0.46 ± 0.03 | RRI, MS |
| 15 | Longiborneol | 2135-2154 | 2141 | 0.52 ± 0.02 | RRI, MS |
| 16 | b-Cedrene | N/A | 2203 | 0.50 ± 0.02 | RRI, MS |
| 17 | b-Atlantone | 2210-2245 | 2217 | 0.60 ± 0.07 | RRI, MS |
| 18 | Deodarone | 2226-2231 | 2230 | 1.09 ± 0.02 | RRI, MS |
| 19 | ɣ-(E) Atlantone | 2231-2316 | 2235 | 1.06 ± 0.01 | RRI, MS |
| 20 | a-(Z) Atlantone | 2231-2316 | 2243 | 1.02 ± 0.03 | RRI, MS |
| 21 | a-(E) Atlantone | 2231-2316 | 2324 | 2.20 ± 0.03 | RRI, MS |
| | Total identified | | | 97.64 | |

[b] Relative retention indices calculated against n-alkanes; % calculated from FID data. Identification method based on the relative retention indices (RRI) of compounds on the HP Innowax column; Mass spectrometer identification was performed on the basis of computer matching of the mass spectra with those of the Wiley and MassFinder libraries and compared with literature data.
[a] These are found in the literature with 50% confidence intervals for the RI data ranges for each compound.

**Table 3. The study participants' sociodemographic and clinical data.**

| Sociodemographic data | n |
|---|---|
| **Gender** | |
| Male | 12 |
| Female | 66 |
| **Age (years)** | |
| 18-29 | 78 |
| **Education Level** | |
| Undergraduate | 78 |
| **Marital Status** | |
| Single | 78 |

significantly ( $p_{G1} > 0.05$; $p_{G2}$, $p_{G3}$, $p_{G4}$, and $p_{G5} < 0.05$). When compared to the control group (WL), the perceived stress scores for the experimental groups G1, G2, G3, and G4 show significant variations or their posttest scores; however, G5 was not significant ($p_{G1}$, $p_{G2}$, $p_{G3}$, and $p_{G4} < 0.05$; $p_{G5} > 0.05$). When mindfulness and aromatherapy are combined, the difference in percentages regarding the pretest and posttest scores for BDI-II are lower than when these therapies are utilized separately (G1= 32.25; G2 = 34.7; G3 = 42.3; G4 = 42.4; G5 = 37.3). The mean scores for the PSS posttest show all interventions to have had an impact on perceived stress levels, with the difference percentages regarding scores being highest for the combination of mindfulness and aromatherapy (G1= 9.4; G2 = 9; G3 = 12.3; G4 = 12.4; G5 = 8.5). As a result of all these findings, both the BDI-II and PSS scores are seen to have significantly decreased (Table 5).

## DISCUSSION

Stress is a phenomenon that individuals are exposed to in daily life. Changes brought about by university life, living away from family, situations encountered during education, and the anxiety of finding a job after graduation can cause students stress. The aim of this study has been to determine the perceived stress levels of university students and to monitor the effects of new complementary therapy systems as an approach to coping with stress. Coping with stress is basically seen as a response to emotions. Different approaches are found that define how an individual copes with stress. Stress and coping theory postulates two types of coping to exist. The first is the problem-focused coping strategy, which involves planned actions to address the issue causing the problem using strategies such as information gathering and decision making. The second is an emotion-focused coping strategy that exists to regulate nega-

**Table 4. Group differences regarding anxiety based on the BDI-II and PSS.**

| Groups | Pretest | Posttest | p[b] |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| **WL** | | | |
| BDI-II | 9.92±3.84 | 10.50±4.503 | 0.765 |
| PSS | 20±2.449 | 19.83±4.324 | 0.837 |
| **G1** | | | |
| BDI-II | 14.77±6.34 | 10±4.933 | 0.006 |
| p-Value[a] | | 0.076 | |
| PSS | 23.77±4.952 | 21.54±3.573 | 0.258 |
| p[a] | | 0.011 | |
| **G2** | | | |
| BDI-II | 17.31±8.25 | 11.31±4.75 | 0.006 |
| p[a] | | 0.009 | |
| PSS | 23.77±4.003 | 21.62±5.316 | 0.248 |
| p[a] | | 0.003 | |
| **G3** | | | |
| BDI-II | 16.92 | 9.77 | 0.017 |
| p[a] | | 0.013 | |
| PSS | 22 | 19.31 | 0.034 |
| p[a] | | 0.072 | |
| **G4** | | | |
| BDI-II | 20.85 | 12 | 0.008 |
| p[a] | | < .001 | |
| PSS | 23.54 | 20.62 | 0.025 |
| p[a] | | 0.001 | |
| **G5** | | | |
| BDI-II | 18.77 | 11.77 | 0.005 |
| p[a] | | 0.002 | |
| PSS | 21.92 | 20.08 | 0.017 |
| p[a] | | 0.106 | |

[a]p-Value is calculated by Kruskal-Wallis Test between groups, [b]p-Value is calculated by Wilcoxon test between study phases

**Table 5. Difference in the pretest and posttest percentages in the intervention groups.**

| Groups | Difference between the Pretest & Posttest Scores (%) |
|---|---|
| **G1** | |
| BDI-II | -32.25 |
| PSS | -9.40 |
| **G2** | |
| BDI-II | -34.7 |
| PSS | -9 |
| **G3** | |
| BDI-II | -42.3 |
| PSS | -12.3 |
| **G4** | |
| BDI-II | -42.4 |
| PSS | -12.4 |
| **G5** | |
| BDI-II | -37.3 |
| PSS | -8.5 |

tive emotions by using strategies such as leaving behind, seeking emotional support, escaping, and avoiding (Folkman, 2020). According to a study conducted on 100 university students, the top five sources of stress involve changes in sleep patterns, holidays/breaks, changes in eating habits, increased workload, and new responsibilities. These stressors cause high levels of stress among students. This situation can be eliminated by creating stress management programs (Ross, Niebling, & Heckert, 1999). A significant relationship was found for the number of close friends an individual has and the type of school that individual attends with that individual's stress level (Durna, 2006). A study conducted with university students sought to answer how students define stress, the most important causes of stress in their lives, and how they cope with stress . Most of the students were seen to define stress as a mental state, with the causes of stress among students being lack of sleep and financial and family problems. The students were seen to have identified certain strategies such as counseling services, meditation, walking around with friends, sharing, and getting adequate sleep for coping with stress (Redhwan, Sami, Karim, Chan, & Zaleha, 2009). Following the session in their study, participants' anxiety levels were seen to have decreased, with each group having lower trait scores than state scores. In addition, the results from the current study demonstrate a reduction in anxiety scores in all experimental groups following their interventions compared to the WL group, particularly in groups G3 and G4 who received concurrent aromatherapy and mindfulness meditation. This suggests a synergy effect that had also been noted in a prior study that also discovered using aromatherapy to treat anxiety to also make mindfulness meditation more effective(Soto-Vásquez & Alvarado-García, 2017). The application of the *Cedrus atlantica* essential oil in G2 exposed them to a substantially higher reduction in anxiety levels after treatment compared to G1, who were just treated with the *Cananga odorata* essential oil. The results regarding G4, who combined the use of CA essential oil with mindfulness meditation, are also consistent with this compared to G3, who used the CO oil with mindfulness meditation.

According to data studies, the sedative effects of CO essential oils are attributed to linalool (14.45%), caryophyllene (12.08%), and benzyl benzoate (7.31%). Linalool exposure has been demonstrated to have sedative effects on a number of mouse behaviors, including locomotion, barbiturate-induced slumber, motor coordination, and body temperature regulation. Previous research has not revealed any anxiolytic action for benzyl benzoate or benzyl alcohol. According to one study, benzyl benzoate could reduce angiotensin II-induced hypertension. A bicyclic sesquiterpene known as caryophyllene works as the

active ingredient in many essential oils from spices and food plants. Studies have shown this to have a wide range of pharmacological effects as a selective cannabinoid receptor 2 (CB2) agonist, including antibacterial (against *Helicobacter pylori*), antioxidant, anti-inflammatory, analgesic (against neuropathic pain), anti-neurodegenerative, and anticancer characteristics. According to published research, the phytocannabinoid caryophyllene, which is found in food, has the ability to protect neurons by reducing oxidative stress and stabilizing mitochondria. This makes it a possible lead molecule for the development of medications for treating neurodegenerative diseases. In addition to CB2 receptor agonism, caryophyllene has been discovered to favorably regulate PPAR-γ, TLRs, and neuroimmune pathways, which are potential targets connected to the defense against neuronal death. Following their reduction of oxidative stress and/or mitochondrial dysfunction, essential oils containing caryophyllene obtained from various vegetable sources have also demonstrated promising neuroprotective effects (Machado et al., 2018; Ullah, Minno, Santarcangelo, Khan, & Daglia, 2021; Zhang, Zhang, Feng, & Yao, 2016).

The anxiolytic effects of CA essential oils are attributed to b- himachalene (49.81%) and a-himachalene (18%). According to Suyono et al., CA essential oil balms decrease the cortisol levels in rats due to α-himachalene, β-himachalene, and γ-himachalene (Suyono, Jong, & Wijaya, 2020). This shows that variations in anxiety ratings might result from a variety of chemical compositions of essential oils, although additional research is required to support this theory.

In comparison to the aromatherapy-only groups (G1 and G2), the scores for the mindfulness meditation group (G5) present a bit more reduction in the BDI-II posttest. This is similar to the findings made by other studies that observed a decrease in anxiety state, trait, or overall anxiety following mindfulness meditation therapies. This is because those who practice mindfulness may understand how to maintain a relaxed state of mind and concentrate on the present moment and to establish an attitude of acceptance and patience toward any unfavorable feelings or thoughts that may surface. However, when compared to the mindfulness meditation group in this study, the degree of change regarding the PSS scores of the aromatherapy-only groups (G1 and G2) shows a little bit more reduction regarding the post-treatment scores (G5). The biggest difference percentage regarding the variable of anxiety is shown by G4 followed by G3. This demonstrates the viability of combining mindfulness and aromatherapy to treat anxiety.

## CONCLUSION

Few studies so far are found to have combined the two variables of aromatherapy and mindful meditation in this way. Through the essential oils of *Cedrus atlantica* and *Cananga odorata*, aromatherapy has developed as a successful therapeutic option for anxiety. The use of essential oils alongside mindfulness meditation is a new method in aromatherapy applications for anxiety. Further studies are nonetheless required to assist in comprehending the synergistic effects of aromatherapy and mindfulness meditation.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Conception/Design of Study- E.Ö.N.; Data Acquisition- E.Ö.N., G.N.K.; Data Analysis/Interpretation- E.Ö.N., G.N.K.; Drafting Manuscript- E.Ö.N.; Critical Revision of Manuscript- E.Ö.N.; Final Approval and Accountability- E.Ö.N., G.N.K.

**Conflict of Interest:** The authors have no conflict of interest to declare.

**Financial Disclosure:** Authors declared no financial support.

**Ethics Committee Approval:** This study was approved by the Altınbaş University's Ethics Committee on January 20, 2022 (Approval No. 97).

**Acknowledgements:** We would like to thank Asst. Prof. Dr. Nilay Aksoy from Altınbaş University, Faculty of Pharmacy for helping with data analyses.

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