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The effect of aromatherapy intervention with Bergamot and Grapefruit essential oils on premenstrual syndrome and menstrual symptoms: a randomized controlled trial

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Abstract

Background Premenstrual syndrome and menstrual symptoms adversely affect approximately 80–95% of women of reproductive age. Aromatherapy interventions are used to reduce premenstrual syndrome and menstrual symptoms. This study was conducted to determine the effect of aromatherapy intervention with bergamot and grapefruit essential oils on premenstrual syndrome and menstrual symptoms.

Methods Ninety women with premenstrual syndrome were included the study. Participants were randomly divided into 3 groups: Bergamot($n=30$), Grapefruit($n=30$), Placebo($n=30$). Participants in each group were made to smell pure essential oil for 30 min 3 times a day for 4 days during the luteal phase of the menstrual cycle. The used was repeated in 3 menstrual cycles. "Premenstrual Syndrome Scale (PMSS)" was used to evaluate premenstrual syndrome and "Menstrual Symptom Questionnaire (MSQ)" was used to evaluate menstrual symptoms. All measurements were performed before and after the study.

Results The results showed that grapefruit essential oil was effective in reducing PMSS total score ($p=0.010$) and sub-scale scores (depressive affect, anxiety, fatigue, depressive thoughts, appetite changes, sleep changes and bloating ($p<0.001$), irritability ($p=0.024$), pain ($p=0.047$)). Although grapefruit essential oil had no effect on the total score of the MSQ. Grapefruit essential oil was found to be effective in reducing the MSQ scale sub-scale scores (menstrual pain symptoms ($p=0.024$) and the use of coping methods with menstrual pain ($p=0.011$)). Bergamot essential oil was found to be effective in reducing PMSS total score ($p=0.001$) and PMSS sub-scale scores depressive affect ($p=0.013$), irritability ($p=0.034$), depressive thoughts and appetite changes ($p=0.026$), pain ($p=0.001$)). In addition, there was no effect on the menstrual syndrome scale and its sub-dimensions ($p>0.05$).

Note: The abstract of this study will be presented as an oral presentation at The 32nd World Congress on Controversies in Obstetrics, Gynecology & Infertility (COGI) congress on November 21–23, 2024 in Lisbon, Portugal.

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Conclusion Grapefruit essential oil was effective in reducing both premenstrual syndrome and menstrual symptoms, whereas bergamot essential oil was only effective in reducing premenstrual symptoms.

Trial registration number NCT06289764 (2024-02-01).

Keywords Aromatherapy, Bergamot essential oil, Grapefruit essential oil, Premenstrual syndrome, Menstrual symptoms

Background

Premenstrual syndrome (PMS) involves psychological, physiological, and behavioral symptoms during the luteal phase in reproductive-age women, which disappear after menstruation begins [1]. Symptoms of PMS include changes in appetite, weight gain, abdominal pain, back pain, lower back pain, muscle and joint pain, headaches, breast swelling and tenderness, nausea, constipation, anxiety, irritability, anger, fatigue, restlessness and mood swings [1, 2]. Worldwide, 251 million women were reported to have PMS in 2019 [3]. In addition to PMS symptoms, it has also been reported that between 34% and 94% of women experience intense symptoms such as dysmenorrhea, nausea, vomiting, fatigue, head, back and joint pain, breast tenderness and diarrhea during menstruation [4, 5].

Premenstrual symptoms and menstrual symptoms are among the biggest problems that negatively affect the health status and quality of life of women of reproductive age worldwide [6, 7]. Safe and effective treatments are therefore needed. Some medications are prescribed for PMS and menstrual symptoms, such as hormone therapies (estradiol and progesterone) or non-steroidal anti-inflammatory drugs (NSAIDs) [8]. However, women turn to complementary and alternative medicine methods (CAM) due to the side effects or ineffectiveness of medicines [9]. CAM is widely used as a low-cost, natural and safe alternative solution to deal with common health problems such as PMS and dysmenorrhea [10, 11].

Aromatherapy is a CAM method using highly concentrated essential oils or essences distilled from plants [12]. The aromatherapy is a noninvasive procedure and its ease of use allows aromatherapy to be widely used [13]. Applied topically, internally or through inhalation, essential oils affect the central nervous system by reaching the neocortex of the brain through the limbic system. The release of blocked energy, which in the context of complementary and alternative medicine (CAM) means balancing the body's natural energy flow, leads to relaxation, calm or arousal. The balanced flow of this energy supports healing and promotes physical and mental well-being [14, 15].

In studies on PMS, aromatherapy was used with *Citrus aurantium*, *Rosa damascena*, *Pelargonium graveolens*, *Citrus junos*, *Lavandula angustifolia* and *Salvia sclarea* essential oils and it was reported that depression, anxiety, irritability and pain perception decreased [16]. In studies conducted during menstruation, aromatherapy with *R. damascena*, *Salvia officinalis*, *Zingiber officinale*, *L. angustifolia* and *Citrus limon* was applied and reported to reduce dysmenorrhea significantly [17, 18, 19]. Studies on women's health have reported that citrus bergemia improves sleep quality and mood in the postpartum period [20]. *Citrus bergamia* (bergamot) essential oil is particularly known for its calming, mood-regulating and analgesic properties. Studies show that bergamot essential oil lowers cortisol levels and supports the nervous system [25, 33]. These effects have been predicted to be beneficial in relieving irritability, depressive affect and pain associated with PMS and menstrual symptoms. On the other hand, although it is known that *Citrus paradisi* (grapefruit) has antibacterial, antimicrobial, antiseptic, antidepressant, anti-edema and appetite-regulating effects, no study on women's health has been found [21]. Limonene and linalool in *C. paradisi* essantial oil have been associated with biochemical mechanisms effective in reducing stress [29, 31]. It is thought that these properties may provide positive effects in the management of PMS and menstrual symptoms.

Although the use of aromatherapy in women's health is widespread, there is no study examining the effect of *C. bergemia* and *C. paradisi* on PMS and menstrual symptoms. The aim of this study was to determine the effect of aromatherapy with bergamot and grapefruit essential oils on premenstrual syndrome and menstrual symptoms.

Methods

Study design and protocol

The study was conducted as an experimental randomized controlled trial between February and June 2024. The primary outcome was premenstrual syndrome and menstrual symptoms. This study' design was carried out with the approval of the KTO Karatay University Faculty of Medicine Non-Pharmaceutical and Non-Medical Device Research Ethics Committee (Date: 15.12.2023, Decision No: 2023/038) and was prospectively registered on clinicaltrials.gov (registration number: NCT06289764). This study was reported according to the recommendations of the Consolidated Standards of Reporting Trials (CONSORT) Statement [22].

Sample and participants

The study was conducted in Konya province located in the Central Anatolia region of Turkey. Research was conducted at a private university between February and June 2024. The population of the study consists of approximately 3000 women of reproductive age who are working and students at a private university in Konya province. The study sample was determined using the G*Power program (version 3.0.10; Franz Foul, Universitat Kiel, Germany). From the pilot study we conducted with nine participants, we calculated that 30 people should be included in each group with an effect size of 0.38, a Type I error of 0.05 and 80% power. However, 99 women aged 18–44 years with premenstrual syndrome were included in the study, considering that 10% of the data might be lost. Among the participants, three participants reported discomfort from odor after starting the intervention, four participants did not comply with the thirty-minute implementation time and did not want to continue with the intervention, and two participants dropped out because they used analgesics. The study was completed with 90 participants. The participants were informed before the study and their consent was obtained. All phases of this study were carried out in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

The inclusion criteria were: 18–45 years of age, premenstrual syndrome scale score above 110, regular menstrual cycle, no chronic diseases. The exclusion criteria were: respiratory diseases such as asthma, bronchitis (self-report), anosmia, pregnancy or suspected pregnancy (self-report), allergy to aromatherapy and essential oils (self-report), abnormal uterine bleeding, use of any contraceptive, use of any other complementary and alternative therapy, fibroids, polycystic ovaries, use of analgesics or hormonal drugs, diabetes, hypertension.

Randomization and blinding

Participants were randomly assigned to one of three study groups (bergamot, grapefruit or placebo) with a 1:1:1 allocation ratio via an Internet-based randomization website (www.randomizer.org) by an independent investigator. All participants were informed that they would be randomly assigned to one of the three study groups. Participants were randomly allocated blindly without knowing which groups were in the study. All outcomes were assessed at baseline and immediately after treatment by a blinded investigator. The results were blinded to the researcher doing the statistics (Groups A, B, C).

Intervention

Participants who volunteered to participate in the study were informed about aromatherapy. Participants who agreed to participate in the study were administered the premenstrual symptom scale in a closed, quiet and single room. Participants who scored 110 points or more on the PMS scale were included in the study. Women with premenstrual syndrome were randomly divided into 3 groups (bergamot essential oil group (c. bergamia), grapefruit essential oil group (c. paradisi) and placebo group (sweet almond oil). The practitioner allocated the oils to be used in brown anonymous oil bottles. Participants were taken to a single, odorless and quiet room. Participants were evaluated before the intervention (pre-test). The completion time of the questionnaire was approximately 10–15 min. Women were randomly provided with a brown bottle and cotton balls (sufficient amounts of oil bottles were distributed to last for three menstrual cycles). During the initial intervention, participants were instructed on how to perform the procedure. They were advised to stop if they felt uncomfortable and to contact the researcher if necessary. Additionally, they were warned about potential complications of aromatherapy, including skin and eye contact with the oil. The intervention was conducted by a researcher specializing in maternity and gynecological nursing, with expertise in aromatherapy interventions. The interventions were administered during the luteal phase (within the seven days preceding menstruation) for four consecutive days, at the same time each day, and three times daily (morning, noon, and evening). The same intervention was administered for three reproductive cycles and the women were followed up by a researcher calling them every day. The researcher instructed the women on how to deliver the intervention while sitting in a bright and odorless environment. They were asked to ventilate the room for 10 min before the intervention (to avoid other odor mixtures in the room). The women were asked to time themselves throughout the intervention and the researcher timed them simultaneously. Participants put three drops of 100% concentrated oil (bergamot essential oil, grapefruit essential oil, sweet almond oil) on a cotton ball and sniffed it from a distance of 15 cm for 30 min. The participant was told that if she felt tired while holding the cotton ball, she could change her hand (for example, if she was holding the cotton ball in her right hand, she could move it to her left hand). At the end of the third month, after the interventions were completed, a post-test was conducted at the end of menstruation (post-test) using a face-to-face interview technique.

Origin and promotion of oils

The essential oils and sweet almond oil used in the study were provided by [by Pharmacienne Hülya Kayhan, Turkey]. The producer declared that it uses certified organic agriculture in the production of the oils. The oils used were obtained by cold press methods. The chemical composition of the supplied oils was confirmed by gas

chromatography-mass spectrometry (GC-MS) analysis. As a result of the analysis, the characteristic components of each oil were determined and compared with the certificates provided by the manufacturer. The oils also have "Ecocert, Agriculture Biologique" certificates. The producer guarantees that the oils used are 100% pure essential oils. In addition, ISO and AFNOR standards were referenced to assess the purity and quality standards of the oils.

Measurements

Information about the participants' age, height, weight and menstruation was collected using a socio-demographic data collection tool prepared by the researcher.

The primary outcome of this study was premenstrual syndrome and menstrual symptoms. The Premenstrual Syndrome Scale (PMSS) was used to measure premenstrual syndrome, and the Menstrual Symptom Questionnaire (MSQ) was used to measure menstrual symptoms.

The Premenstrual Syndrome Scale (PMSS) is a five-point Likert-type scale consisting of 44 questions developed by Gençdoğan (2006) to measure the severity of premenstrual symptoms. In the scoring of the scale, "Never" option is evaluated as 1 point, "Very rarely" option as 2 points, "Sometimes" option as 3 points, "Frequently" option as 4 points and "Continuously" option as 5 points. The scale has a total of 9 sub-dimensions including depressive affect, anxiety, fatigue, irritability, depressive thoughts, pain, appetite changes, sleep changes, and bloating. The PMSS is administered by retrospectively assessing the person's "being within one week before menstruation". "PMSS Total Score" is obtained from the sum of the scores obtained from all sub-dimensions. A minimum score of 44 and a maximum score of 220 can be obtained from the scale. The higher the score obtained from the scale, the higher the intensity of premenstrual symptoms. Premenstrual symptoms is considered as "present" if it exceeds 50% (110) of the PMSS total scale score (220) [23]. The cronbach alpha value of the scale is 0.75.

The Menstrual Symptom Questionnaire (MSQ) was developed in English by Chesney and Tasto in 1975 to assess menstrual pain and symptoms. Negriff et al. reevaluated and updated the factor structure and usability on adolescents in 2009. The scale was adapted into Turkish by Güvenç et al. in 2014. The scale is a five-point Likert-type scale consisting of 22 items. Participants are asked to assign a number between 1 (never) and 5 (always) to the symptoms they experience related to menstruation. The scale items are numbered according to the factors for ease of use. Items 1–13 belong to the "Negative effects/somatic complaints" subscale, items 14–19 belong to the "Menstrual pain symptoms" subscale and items 20–22 belong to the "Coping methods" subscale. The score obtained from the sub-dimensions is calculated by averaging the total score of the items in the sub-dimensions. An increase in the mean score for the sub-dimensions indicates an increase in the severity of menstrual symptoms related to that sub-dimension [5]. The cronbach alpha value of the scale is 0.92.

Data analysis

The SPSS 25 programme (IBM Corp., Armonk, NY, USA) was used to analyze the data. Homogeneity of variances, which is one of the prerequisites of parametric tests, was checked with "Levene's test". The normality assumption was checked with the "Shapiro-Wilk" test. Descriptive statistics (mean, standard deviation, number and percentile) were reported for categorical and continuous variables. Kruskal-Wallis test was used for multi-group comparisons. Chi-square test was used to examine the relationships between categorical variables. Comparison of parameters between pre- and post-treatment measurements was performed using Paired Sample T test for parametric data and Wilcoxon test for non-parametric data. One-way ANOVA was used to test the differences between groups at the same time interval. Tukey post hoc tests were used for multiple comparisons. In this study, the significance level was set as $p < 0.05$ for all analyses.

Results

Ninety-nine women of reproductive age with premenstrual syndrome were included in the study. Four of the participants did not want to continue with the intervention, three reported feeling uncomfortable with the odor after starting the intervention, and two reported using analgesics during the intervention. For these reasons, nine people who did not complete the study (Fig. 1). The ages of the participants ranged between 18 and 44 years with a mean of 22.43 ± 4.97 years. The mean age at menarche was 13.00 ± 1.45 years, mean duration of menstruation was 6.00 ± 1.31 days and mean duration of menstrual cycle was 28.00 ± 3.52 days. Demographic and menstrual characteristics of the women who participated in the study are given in Table 1.

The participants had similar premenstrual symptom scale, menstrual symptom scale total score and subparameter scores before the study ($p > 0.05$) (Table 2).

Pre- and post- aromatherapy intervention differences were evaluated, and it was determined that there was a decrease in PMSS total score in the grapefruit ($p = 0.010$) and bergamot essential oil group ($p < 0.001$), while there was an increase in the control group ($p = 0.013$). PMSS subscale scores are given in Table 3. MSQ total score did not change significantly in the grapefruit ($p = 0.112$) and bergamot essential oil group ($p = 0.762$), whereas there was an increase in the control group ($p < 0.001$). The MSQ sub-dimension scores are given in Table 3.

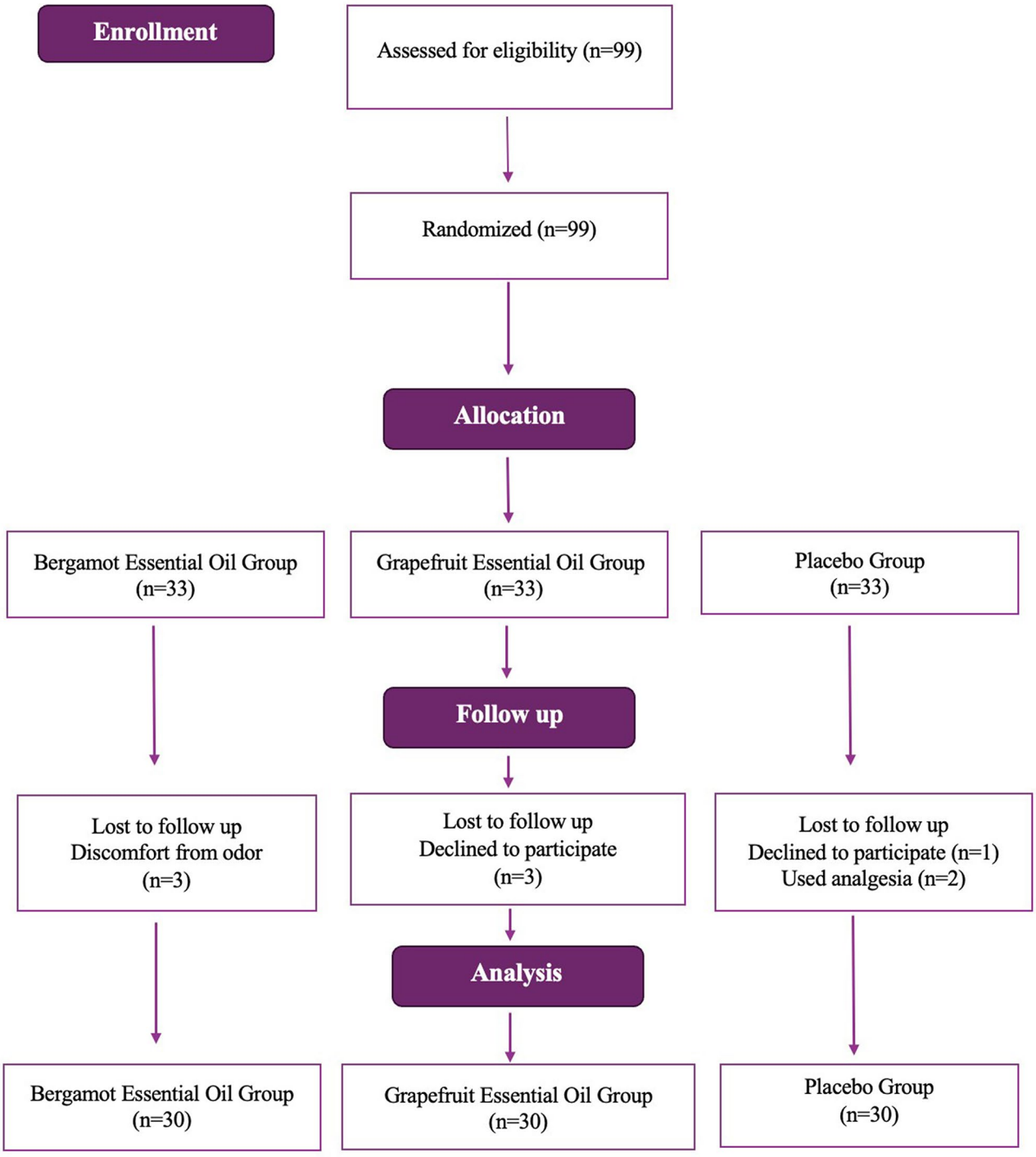

Fig. 1 CONSORT flow diagram of the study

Discussion

Premenstrual syndrome (PMS) and menstrual symptoms significantly impact the lives of reproductive-age women. This study examines the effects of inhalation aromatherapy using grapefruit and bergamot essential oils on PMS and menstrual symptoms. Results showed that aromatherapy with both oils reduced PMS complaints, but only grapefruit essential oil significantly reduced menstrual complaints. Bergamot essential oil had no significant effect on menstrual symptoms.

In aromatherapy research, inhalation is noted as more effective for managing symptoms like dysmenorrhea [24]. This study involved women inhaling grapefruit and bergamot essential oils for 30 min, three times a day, over

Table 1 Demographic and menstrual characteristics of participants

	Grapefruit Essential Oil Group (*n* = 30) (X ± SD, *n* (%))	Bergamot Essential Oil Group (*n* = 30) (X ± SD, *n* (%))	Placebo Group (*n* = 30) (X ± SD, (%))	*p*
Age (year)	23.76 ± 7.82	21.23 ± 2.82	22.30 ± 1.85	.141[a]
Menarche age (year)	13.33 ± 1.70	13.46 ± 1.22	13.26 ± 1.43	.866[a]
Frequency of menstruation (day)	26.70 ± 4.09	27.76 ± 3.04	26.33 ± 3.30	.265[a]
Menstruation duration(day)	6.23 ± 1.52	5.73 ± 1.20	6.06 ± 1.20	.331[a]
BMI	22.61 ± 3.51	23.59 ± 4.13	22.19 ± 3.27	.322[a]
Presence of PMS symptoms in mother or sister				
Yes	25(83.3%)	24 (%80)	20(%66.7)	.271[b]
No	5(16.7%)	6(%20)	10 (%33.3)	
Smoking				
Yes	6(20%)	5(16.7%)	12 (40%)	.081[b]
No	24(80%)	25(83.3%)	18 (60%)	
Alcohol use				
Yes	1(3.3%)	1(3.3%)	2(6.7%)	.770[b]
No	29(96.7%)	29(96.7%)	28(93.3%)	

M: mean; SD: standard deviation; n: number; %: percantange, a: One way ANOVA b: chi-square; $p < 0.05$

Table 2 Pre-study premenstrual syndrome scale total score and sub-scale score, menstrual symptom questionnaire total score and sub-scale score

	Grapefruit Essential Oil Group (X ± SD)	Bergamot Essential Oil Group (X ± SD)	Placebo Group (X ± SD)	*p*
PMSS Sub-scale				
Depressive affection	25.13 ± 4.42	26.90 ± 4.10	25.56 ± 4.09	.179[b]
Anxiety	23.40 ± 3.55	22.93 ± 3.79	23.50 ± 5.42	.587[a]
Fatigue	23.30 ± 4.12	24.03 ± 4.31	22.33 ± 4.22	.360[b]
Nervousness	18.56 ± 4.09	18.80 ± 4.55	16.93 ± 3.30	.001[b]
Depressive Thoughts	25.40 ± 4.61	25.00 ± 4.16	23.63 ± 4.09	.314[b]
Pain	11.63 ± 1.86	11.50 ± 2.80	10.70 ± 2.16	.101[b]
Appetite Changes	10.66 ± 2.66	11.26 ± 3.03	11.06 ± 2.50	.561[b]
Sleep Changes	11.06 ± 2.37	10.56 ± 2.28	10.26 ± 1.77	.355[a]
Bloating	10.90 ± 1.91	11.00 ± 3.09	10.63 ± 2.25	.111[b]
PMSS Total	160.06 ± 20.49	162.00 ± 20.77	154.63 ± 18.90	.302[b]
MSQ Sub-scale				
Negative Effects (Somatic Symptoms)	45.53 ± 11.71	45.60 ± 11.38	42.17 ± 10.68	.416[a]
Menstrual Pain	24.00 ± 5.29	21.96 ± 5.69	21.82 ± 5.76	.285[b]
Coping Methods	10.80 ± 3.84	9.73 ± 3.92	9.44 ± 3.32	.279[b]
MSQ Total	77.03 ± 17.75	73.46 ± 18.29	70.31 ± 16.25	.236[b]

X, mean; SD, standard deviation; Premenstrual Syndrome Scale, PMSS; Menstrual Symptom Questionnaire, MSQ; a, Anova; b, Kruskal Vallis; $p < 0.05$

four days each week, for three consecutive menstrual cycles. The findings revealed a significant reduction in premenstrual symptoms, particularly in depressive affect, with grapefruit essential oil showing more consistent results. In contrast, the placebo group, using sweet al.mond oil, showed an increase in premenstrual symptoms, especially depression, highlighting the mood-regulating potential of aromatherapy. The anxiolytic and antidepressant effects of grapefruit and bergamot essential oils are attributed to active components like limonene, which influences the central nervous system [25, 26, 27, 28].

Grapefruit essential oil also significantly reduced anxiety symptoms, while bergamot essential oil showed a non-significant reduction. In the placebo group, there was a slight increase in anxiety symptoms. Limonene's calming properties on the central nervous system may explain grapefruit essential oil's effectiveness in reducing anxiety [29]. This finding is consistent with previous studies showing that aromatherapy, particularly using grapefruit essential oil, reduces anxiety levels [16, 26]. The mild effects observed with bergamot essential oil suggest its anxiolytic effects may be weaker than grapefruit's.

The study also assessed the impact of these essential oils on fatigue. Grapefruit essential oil significantly reduced fatigue, while bergamot essential oil showed a minor, non-significant reduction. The placebo group experienced a slight increase in fatigue. The stimulating properties of grapefruit essential oil, driven by limonene, likely contributed to its success in reducing fatigue, while bergamot's effects were weaker, possibly due to its more relaxing and less invigorating nature [30, 32].

Irritability was significantly reduced in both the grapefruit and bergamot essential oil groups, while the placebo group experienced an increase in irritability. The results of this study were similar to studies showing the effect of aromatherapy on irritability [25, 33]. The mood-regulating properties of essential oils may contribute to their ability to alleviate irritability [34].

Table 3 Evaluation of the differences in premenstrual syndrome scale total score, sub-scale score and menstrual symptom questionnaire total score, sub-scale score before and after aromatherapy intervention

	Grapefruit Essential Oil Group			Bergamot Essential Oil Group			Placebo Group		
	Pre-test X ± SD	Post-test X ± SD	*p*	Pre-test X ± SD	Post-test X ± SD	*p*	Pre-test X ± SD	Post-test X ± SD	*p*
PMSS Sub-scale									
Depressive affection	25.13 ± 4.42	17.43 ± 4.21	**< 0.001****	26.90 ± 4.10	23.73 ± 5.22	**0.013****	25.56 ± 4.09	26.53 ± 5.94	0.452**
Anxiety	23.40 ± 3.55	14.93 ± 5.30	**< 0.001***	22.93 ± 3.79	21.30 ± 6.91	0.313*	23.50 ± 5.42	25.63 ± 7.06	0.344*
Fatigue	23.30 ± 4.12	19.33 ± 6.50	**.004***	24.03 ± 4.31	22.76 ± 4.74	0.173*	22.33 ± 4.22	24.00 ± 4.49	0.160*
Nervousness	18.56 ± 4.09	14.83 ± 5.25	**0.012***	18.80 ± 4.55	16.80 ± 4.78	**0.034***	16.93 ± 3.30	20.60 ± 3.56	**< 0.001***
Depressive Thoughts	25.40 ± 4.61	18.00 ± 7.83	**< 0.001***	25.00 ± 4.16	22.06 ± 6.78	**0.026***	23.63 ± 4.09	27.30 ± 5.91	**0.014**
Pain	11.63 ± 1.86	9.20 ± 3.46	**0.047****	11.50 ± 2.80	10.36 ± 3.03**	**0.001****	10.70 ± 2.16	12.16 ± 2.84	**0.030****
Appetite Changes	10.66 ± 2.66	8.33 ± 3.07	**0.001***	11.26 ± 3.03	9.83 ± 3.09	**0.026***	11.06 ± 2.50	11.73 ± 2.77	0.286*
Sleep Changes	11.06 ± 2.37	8.03 ± 3.31	**0.001***	10.56 ± 2.28	10.16 ± 3.23	0.466*	10.26 ± 1.77	12.26 ± 2.33	**0.001***
Bloating	10.90 ± 1.91	3.30 ± 2.96	**0.001***	11.00 ± 3.09	10.23 ± 3.34	0.232*	10.63 ± 2.25	12.40 ± 2.38	**0.010***
PMSS Total	160.06 ± 20.49	118.40 ± 33.30	**0.010***	162.00 ± 20.77	147.26 ± 32.92	**0.001***	154.63 ± 18.90	172.63 ± 30.42	**0.013***
MSQ Sub-scale									
Negative Effects (Somatic Symptoms)	45.53 ± 11.71	41.83 ± 13.28	0.088*	45.60 ± 11.38	42.96 ± 10.86	0.129*	42.17 ± 10.68	49.30 ± 9.38	**.002***
Menstrual Pain	24.00 ± 5.29	20.86 ± 6.96	**0.024****	21.96 ± 5.69	21.63 ± 5.35	0.587**	21.82 ± 5.76	23.86 ± 4.68	0.144**
Coping Methods	10.80 ± 3.84	8.73 ± 3.41	**0.011****	9.73 ± 3.92	9.43 ± 3.37	0.787**	9.44 ± 3.32	11.86 ± 2.43	**0.002****
MSQ Total	77.03 ± 17.75	71.43 ± 21.82	0.112*	73.46 ± 18.29	74.03 ± 18.24	0.762*	70.31 ± 16.25	85.03 ± 15.55	**< 0.001***

X, mean; SD, standard deviation, Premenstrual Syndrome Scale, PMSS; Menstrual Symptom Questionnaire, MSQ; Wilcoxon test, *: Paired samples t test, * *

Aromatherapy also showed positive results in reducing pain symptoms, with both oils proving effective. Grapefruit essential oil's analgesic and anti-inflammatory effects, especially due to limonene, may help reduce pain, aligning with other studies that support aromatherapy for pain relief. The placebo group, however, experienced an increase in pain, reinforcing the benefits of aromatherapy interventions [5, 29, 31, 35, 36].

The study further found that aromatherapy with grapefruit essential oil significantly reduced appetite changes, while bergamot essential oil had a non-significant effect. The placebo group showed a slight increase in appetite changes. Grapefruit essential oil's metabolic and mood-regulating effects may explain its ability to reduce appetite fluctuations, a finding consistent with the role of aromatherapy in influencing mood and metabolism [25, 32].

Aromatherapy with grapefruit essential oil also significantly improved sleep, while bergamot essential oil showed a non-significant decrease in sleep disturbances. The placebo group, however, experienced a significant increase in sleep problems. Grapefruit essential oil's sedative and sleep-regulating properties, particularly due to limonene, may explain its positive effects on sleep. Studies suggest that aromatherapy interventions can enhance sleep quality, reinforcing the findings of this research [25, 37, 38].

Swelling was another symptom examined, with both oils significantly reducing swelling, though bergamot essential oil's effects were non-significant. The placebo group showed a significant increase in bloating. The antispasmodic and carminative properties of limonene in grapefruit essential oil may have contributed to the reduction in bloating, while bergamot essential oil's effects were milder [25, 32, 39].

Finally, the study concluded that aromatherapy with grapefruit and bergamot essential oils reduced women's reliance on coping strategies for menstrual symptoms. The placebo group, by contrast, saw an increase in the use of coping methods. Grapefruit essential oil's effectiveness in reducing the need for coping mechanisms could be linked to its relaxing and anti-inflammatory properties, which help manage symptoms physically and mentally [27, 29]. The study suggests that aromatherapy, especially with grapefruit essential oil, offers a promising alternative to traditional coping strategies for menstrual discomfort.

In conclusion, aromatherapy with grapefruit and bergamot essential oils has a notable impact on PMS and menstrual symptoms, with grapefruit essential oil showing stronger and more consistent benefits across various symptoms. The findings highlight the potential of essential oils, particularly grapefruit essential oil, in managing mood, pain, fatigue, irritability, and other PMS-related complaints [40, 41].

Limitations

This study has several limitations. Many PMS symptoms, such as pain and mood changes, are subjective, which introduces a potential risk of bias due to self-reported data. Additionally, the small sample size limits the generalizability of the findings. Furthermore, although participants were randomized into treatment groups, blinding was not possible, as they could identify the essential oil provided to them. This is a common challenge in aromatherapy research and was considered during data interpretation.

Conclusion

Aromatherapy is non-invasive, safe and potentially effective. Studies show its effectiveness in the management of premenstrual syndrome and menstrual symptoms and improves the quality of life of women of reproductive age. This study supports this hypothesis. Our results investigated the potential benefits of grapefruit and bergamot essential oils in the management of premenstrual syndrome (PMS) and menstrual symptoms. These results suggest that aromatherapy may be a non-invasive, safe and effective method. Aromatherapy with grapefruit and bergamot essential oils significantly reduced PMS-related complaints such as depressive affect, irritability, pain and appetite changes. Grapefruit essential oil showed particularly significant effects on anxiety, fatigue, bloating and sleep disturbances. Bergamot essential oil showed a more limited effect on these symptoms. A significant increase in PMS symptoms was observed in the placebo group, supporting the potential effect of aromatherapy. Coping strategies for menstrual symptoms and somatic complaints tended to decrease with grapefruit essential oil. These results suggest that aromatherapy, especially using grapefruit essential oil, can be used as an adjunctive method in the management of PMS and menstrual symptoms.

Future perspective

In this study, we demonstrated the potential effects of grapefruit and bergamot essential oils in the management of premenstrual syndrome (PMS) and menstrual symptoms. However, more comprehensive and long-term studies on the use of aromatherapy in this field would be appropriate.

- • Future studies with larger and more diverse sample groups will increase the generalizability of the findings and allow for the evaluation of the effect of aromatherapy in different populations.
- • Comparative studies evaluating the effects of different aromatherapy essential oils or essential oil combinations on PMS and menstrual symptoms could make an important contribution in this field.
- • Studies examining the effectiveness of different methods (e.g. inhalation, massage, bathing) and oil concentrations used in aromatherapy applications are essential to determine the most effective application protocols.
- • Studies examining the relationship between aromatherapy practices and psychosocial and cultural factors may contribute to the development of individualized approaches.
- • Especially since aromatherapy interventions are non-invasive interventions and nonpharmacological methods, their integration into clinical practice is very important.

Integration of aromatherapy into clinical practice as a complementary modality in PMS and menstrual symptom management should be explored, implemented and guidelines for health professionals should be established. These recommendations and perspectives serve as a guide to strengthen the place of aromatherapy practices in the management of PMS and menstrual symptoms and to advance research in this field. Future studies may contribute to the wider use of this safe, accessible and non-invasive method for women's health.

Abbreviations

PMS	Premenstrual syndrome
NSAIDs	Non-steroidal anti-inflammatory drugs
CAM	Alternative medicine methods
PMSS	Premenstrual Syndrome Scale
MSQ	Menstrual Symptom Questionnaire

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12906-025-04857-3.

Supplementary Material 1

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Author contributions

E.Ö: Conceptualization; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing.Ş.İ.D: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing.H.D.T; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft.

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Data availability

Data is provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate

This study' design was carried out with the approval of the KTO Karatay University Faculty of Medicine Non-Pharmaceutical and Non-Medical Device Research Ethics Committee (Date: 15.12.2023, Decision No: 2023/038). Participants were informed about the study before the study and informed consent was obtained. All stages of this study were conducted in accordance with the Declaration of Helsinki [42].

Competing interests

The authors declare no competing interests.

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