

The Effects of Olfactory Stimulation by Tree Peony Flowers on Autonomic Nervous System, Emotional States, and Brain Electrical Activity

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Research

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Abstract

Background: The tree peony is an important ornamental plant with many cultivars and rich fragrances. The scents released from the flowers of various tree peony cultivars might impose different influences on psycho-physiological responses, which seem to be the gap in the present research.

Methods: We investigated psycho-physiological responses of 80 students (23.9 ± 2.25 years old) to the olfactory stimulation by the four types of tree peony fragrances, including the phenolic scent (PS), rose scent (RS), woody scent (WS), and lily of the valley scent (LVS). The present study assessed autonomic parameters such as heart rate (HR) and heart rate variability (HRV) to determine the arousal levels of the autonomic nervous system. Psychological evaluation was carried out using the Profile of Mood States (POMS) and semantic differential methods (SDM). Electroencephalography (EEG) was recorded during tree peony fragrance inhalation periods compared with control conditions.

Results: The students exhibited significantly higher parasympathetic nervous activities, but significantly lower sympathetic nervous activities and heart rates after inhaling tree peony fragrances. The four kinds of tree peony fragrances induced significantly less negative and more vigorous moods, and obtained better scores in subjective evaluation, especially the rose scent. Furthermore, the analysis of EEGs showed a remarkable increase in the power of low alpha (8-10 Hz), high alpha (10-12 Hz), and theta (4-7 Hz) waves.

Conclusions: Our studies demonstrated that a short olfactory stimulation with the four peony scents would be not only a promising therapeutic method for improving physiological function but also an effective psychological relaxation strategy for the participants.

Background

As early as more than 100 years ago, some researchers put forward the concept of "aromatherapy", which is a holistic approach that takes into account the need of the human body, mind, and heart, as well as the state of the living environment. In recent years, breakthroughs have been made in the collection, separation, and identification of plant volatile organic compounds (VOCs) [1], which proves that the health-protective effect of aromatherapy or floral therapy mainly benefits from some volatile components emitted by plants [2, 3]. Several studies have suggested that the stimulation by essential oils inhalation on human physiology and psychology, which includes making people in a relaxed state, improving work efficiency, making person's body and mind in balanced and harmonious conditions to achieve the goal of preventing and treating diseases [4–7].

The main components of plant aroma are monoterpenoids and sesquiterpenoids, which have high physiological activities and are closely related to human health [8]. Different plant essential oil inhalations have been found to regulate different emotions [9, 10]. Jasmine essential oil can make the human body to alleviate tension, so as to relax, and let the agility decline. Peppermint essential oil and 1, 8-eucalyptus oil can make the human mind refreshing [5]. The studies on the relationship between floral

fragrance and work efficiency in Japan have indicated that smelling vanilla, jasmine scent, and lemon scent can reduce a person's work error by 20%, 33%, and 54%, respectively [11].

Aromatherapy is a natural technique for a therapeutic support of the people by absorbing aromatic molecules which enter the blood to play the pharmacological activity of spices, leading to the changes in human physiological response. Presently, the research on aromatherapy mainly focuses on the autonomic nervous system composed of parasympathetic nerve and sympathetic nerve. The changes of heart rates, blood pressures, brain waves, respiratory rates, and other physiological indexes are detected by corresponding instruments. Several studies have showed significant decreases in blood pressures, heart rates, and respiratory rates after inhalation of lavender essential oil and Citronella [12, 13]. By contrast, the inhalation of lavender oil causes an increase in diastolic blood pressures and heart rates [14]. Rosemary oil inhalation can significantly increase blood pressures, heart rates, and respiratory rates [15]. Some researchers studying brain wave activities also show different results. For example, lavender has been demonstrated to increase theta1 and decrease beta1 brain wave activities which are associated with relaxation [16]. The power of alpha and beta brain activities was increased after inhaling citronella oil [17]. A reduction in the power of alpha1 and alpha2 waves, and an increment in the power of beta wave observed in the anterior region of the brain after inhaling rosemary oil [15].

The different effects of plant essential oil on people's physiology and psychology have been well documented, as described above. However, limited studies have been performed to examine the effects of flower fragrances on the people. The olfactory stimulation by fresh rose flowers induced physiological and psychological relaxation [18]. Aromatic plants nature incense has functioned actively for blood pressure reduction and subjects' mental outlook [19]. Besides, the green olfactory quality of *Sorbaria kirilowii* is not conducive to the production of stability, relaxation, pleasant, and comfortable moods [20]. Therefore, understanding the effects of plant volatiles and volatile environment on human psycho-physiological responses is imperative. Furthermore, most studies have been accomplished with the scent of a flower cultivar [18, 20]. However, the scents released from the flowers of various plant cultivars might impose different influences on psycho-physiological responses, which seem to be the gap in the present research.

The tree peony is an important ornamental plant with many cultivars and rich fragrances. According to major fragrances and the results of sensory evaluation, a previous study has identified four peony fragrance patterns: a phenolic scent (PS), a rose scent (RS), a woody scent (WS), and a lily of the valley scent (LVS) [21]. The present study therefore investigated students' physiological and psychological responses to the four types of peony fragrances mentioned above. We measured physiological parameters including heart rates, heart rate variability (HRV), and electroencephalography (EEG) during peony fragrance inhalation. We also recorded the psychological indices including the Profile of Mood State (POMS) and semantic differential methods (SDM) in pre- and post- peony fragrance inhalation. The purpose of this study is to determine the effects of four peony fragrances in psycho-physiological indices, and provide a theoretical basis for the healthy indoor environment construction.

Materials And Methods

Participants

Eighty participants with equal number of male and female aged between 20 and 28 years (mean age 23.9 ± 2.25 years) were selected in this study. All participants were volunteer college students with normal sense of smell from Northwest A & F University, Yangling, China. These subjects were randomly divided into four groups (each group of 20 students) to participate in the fragrance experiments. And the participants with symptoms of upper respiratory tract infection, neurological or psychiatric disorders, hypertension, cardiovascular diseases or a history of smoking were excluded from this study [22]. Also, the female subjects who were menstruating on the day of testing were also excluded [23]. All subjects were advised to try to sleep well before the day of the experiment to avoid feeling fatigued or drowsy. In addition to the exclusion criteria outlined above all participants were given routine information for subjects preparing for an EEG recording, such as they were not allowed to apply any sprays, antiperspirants or perfumes to their hair twelve hours prior to testing [17]. The participants were given a full explanation of the research and a written informed consent of all aspects of the present study, and were free to withdraw at any time.

Experimental Materials

All the plant materials were collected in the morning (between five and seven o'clock) during the initial flowering phase (from April 12 to April 15). Tree peony cut flowers from eleven tree peony cultivars were collected in the botanical garden of Yang Ling (Shaanxi, P. R. China), located in the Northwest A & F University. These cut flowers were divided into four aroma groups, including phenolic scent (PS) ('*Chang Kang Le*', '*Chu E Huang*'), rose scent (RS) ('*Hu Die Bao Chun*', '*Zi Luo Lan*', '*Xue Lian*'), woody scent (WS) ('*Tian Xiang*', '*Yin Hong Qiao Du*', '*Feng Dan*'), and lily of the valley scent (LVS) ('*High Noon*'). Each aroma group maintained the same number of the tree peony cut flowers (15 cut flowers). Before the beginning of the experiment, we used the preservation technology to make these cut flowers alive and to prevent them from falling off at the experimental stage.

Experimental Design

All aroma experiments were carried out in the fume hood of the silent room with an ambient temperature of $24 \pm 2^\circ\text{C}$ and 40-60% humidity. The fume hood is a fully managed small space where the concentration of aroma is better controlled. Before the experiments, the tree peony cut flowers, were put on the operating station of the fume hood, and covered with black gauze to avoid the interference of flower colors. When the peony fragrance filled the fume hood, we opened the toughened glass door and allowed the subjects to smell by approaching the tree peony cut flowers. Then, we shut the toughened glass door for 5 minutes to regain the same aroma concentration as before. After completing one aroma group experiment, we turned on the air brake to remove the former aroma and continued the next experiment.

The A-B design was used so that each individual session consisted of two trials. This design was chosen because the time course of olfactory stimulation effects is unknown, which might make results obtained from other designs, such as A-B-A, difficult to interpret [5]. All experiments were conducted in the morning from 13 to 16 in April 2018. At the beginning of the experiment, the researcher were informed about the procedure. The subjects were then given sufficient time to adapt to the room environment, and also instructed to turn off mobile phones. The test consisted of two trials: first session served as a control group (resting period) and took five minutes. After completion of the first session, the subjects were asked to rate the Profile of Mood State (POMS). The second session took five minutes to ask the subjects to inhale the flower fragrance. The POMS and the SDM scales were measured and assessed after peony fragrance inhalation. During each trial, the portable EEG headset and Polar V 800 were installed to the participants. EEG and heart rate variability (HRV) were recorded in two sessions (Fig. 1). The four aroma group experiments, *i.e.* a phenolic scent (PS), a rose scent (RS), a woody scent (WS), and a lily of the valley scent (LVS) were completed following the above procedures, respectively.

Autonomic nervous system (ANS) and mood measurement

HRV and heart rates, which were used to quantify autonomic nervous system responses, were measured using a wearable electrocardiogram sensing system (Polar V 800; Polar Electro. Oy, Finland). Frequency spectra were generated using a graphical software tool for heart rate variability analysis (Dpt. Informatics; University of Vigo; Spain) [24]. The power levels of the low frequency (LF; 0.04-0.15 Hz) and high frequency (HF; 0.15-0.40 Hz) components of HRV were calculated using the maximum entropy method, and heartbeat (R-R) intervals were obtained continuously. The HF component is considered to reflect the parasympathetic nervous activity. Furthermore, the LF/HF ratio is an estimate of sympathetic nerve activity [25].

The mood state was examined based on the Profile of Mood State (POMS) [26] and semantic differential methods (SDM). The POMS questionnaire consisted of 30 questions and was divided into 6 dimensions: tension-anxiety (T-A), anger-hostility (A-H), fatigue-inertia (F-I), depression-dejection (D-D), confusion-bewilderment (C-B) and vigor-activity (V-A). A higher score for each dimension showed a higher degree of the specified emotion. The SDM has been found to be a reliable and valid way to quantify subjective feelings about external stimuli. In this study, 15 pairs of contrary adjectives were used to rate the subjects' feelings and impressions of peony fragrance inhalation by a seven-point scale from -3 (most positive) to 3 (most negative).

Electroencephalogram (EEG) recording

Electroencephalogram (EEG) is often used to record human brainwave activities from the Fp1 position above the eye. Fluctuations in cerebral activities resulting from the peony fragrance inhalation were measured by a portable EEG headset (NeuroSky, Beijing CUSoft Co., Ltd, China). This headset consists of three essential parts: (i) a headband; (ii) an ear-clip; and (iii) a sensor arm containing the EEG electrode and Bluetooth USB. In our study, brainwave data of the respective frequencies derived by Mind Wave EEG

were expressed as follows: delta (0.1-3 Hz), theta (4-7 Hz), low alpha (8-10 Hz), high alpha (10-12 Hz), low beta (12-20 Hz), high beta (21-30 Hz), low gamma (30-65 Hz), and high gamma (65-100 Hz).

Data and statistical analysis

The SPSS statistical package 19.0 (IBM® SPSS® Statistics, Armonk, New York) was used for data analysis. A paired sample *t*-test was carried out to calculate the means concerning HRs, LF and LF/HF as well as the brainwaves and rating of mood states in two steps (control and experimental groups) treatments. These means for physiological and mood states among the experimental groups after inhaling the four peony fragrances were determined by one-way analysis of variance (ANOVA). The data were expressed as the mean \pm standard deviation (mean \pm SD). In all comparisons, a *p*-value of <0.05 was considered statistically significant. The effect size was reported using Cohen's *d*.

Results

The results of the autonomic nervous system parameters showed that the heart rate (HR) mean values after inhaling the four peony fragrances were lower than those after the resting periods, and showed a decreasing trend during the five minutes (Fig. 2). The paired samples *t*-test indicated that there were significant differences in the HR ($p \leq 0.01$ for all fragrance groups, with Cohen's *d* varying from 0.75 to 1.08), LF/HF ($p \leq 0.05$ for all fragrance groups, $d = 0.65-0.77$), and HF ($p \leq 0.05$ for all fragrance groups, $d = 0.80-0.90$) of the subjects inhaling the four peony fragrances, respectively, compared to the resting periods (Fig. 2, 3). One-way analysis of variance revealed that there was no significant difference in HR ($p = 0.426$, $\eta_p^2 = 0.036$), LF/HF ($p = 0.546$, $\eta_p^2 = 0.027$), and HF ($p = 0.997$, $\eta_p^2 = 0.001$) for the four different fragrances.

The results of the EEG showed that the mean values of delta, low gamma, and high gamma after inhaling the different peony fragrances were lower than those after inhaling the control groups, but the mean values of theta, low alpha, high alpha, low beta, and high beta were higher (Fig. 4). After paired *t*-tests, there was a significant difference between the control and experimental groups in the mean values of theta ($p \leq 0.05$ for all fragrance groups, $d = 0.53-0.70$), low alpha ($p \leq 0.05$ for all fragrance groups, $d = 0.56-0.95$), and high alpha ($p \leq 0.05$, for all fragrance groups, $d = 0.58-0.97$) of all participants (Fig. 3). However, the delta ($p \leq 0.05$, for all fragrance groups, $d = 0.32-0.50$), low beta ($p \leq 0.05$, for all fragrance groups, $d = 0.45-0.70$), high beta ($p \leq 0.05$, for all fragrance groups, $d = 0.28-0.60$), low gamma ($p \leq 0.05$, for all fragrance groups, $d = 0.30-0.63$), and high gamma ($p \leq 0.05$, for all fragrance groups, $d = 0.45-0.56$) results showed no significant difference. Comparing the brainwave mean values among the four different fragrances, One-way analysis of variance revealed that there was no significant change in delta ($p = 0.626$, $\eta_p^2 = 0.023$), theta ($p = 0.095$, $\eta_p^2 = 0.080$), low alpha ($p = 0.183$, $\eta_p^2 = 0.061$), high alpha ($p = 0.763$, $\eta_p^2 = 0.015$), low beta ($p = 0.342$, $\eta_p^2 = 0.043$), high beta ($p = 0.102$, $\eta_p^2 = 0.078$), low gamma ($p = 0.410$, $\eta_p^2 = 0.037$), and high gamma ($p = 0.155$, $\eta_p^2 = 0.066$), respectively.

Paired t-tests showed that all of the POMS scores revealed significant changes after inhaling the different peony fragrances. Compared with the control groups, the negative subscales of the POMS, tension-anxiety (T-A) ($p \leq 0.05$ for all fragrance groups, $d = 0.33-0.79$), anger-hostility (A-H) ($p \leq 0.05$ for all fragrance groups, $d = 0.62-0.98$), fatigue-inertia (F-I) ($p \leq 0.01$ for all fragrance groups, $d = 0.40-1.09$), depression-dejection (D-D) ($p \leq 0.05$ for all fragrance groups, $d = 0.59-1.01$), and confusion-bewilderment (C-B) ($p \leq 0.05$ for all fragrance groups, $d = 0.56-0.68$), substantially decreased from the resting to inhaling. Conversely, the positive mood states (vigor-activity (V-A)) significantly increased ($p \leq 0.05$ for all fragrance groups, $d = 0.43-0.69$) (Fig. 5). One-way analysis of variance revealed that mean values of the T-A ($p = 0.770$, $\eta_p^2 = 0.015$), A-H ($p = 0.053$, $\eta_p^2 = 0.096$), F-I ($p = 0.280$, $\eta_p^2 = 0.049$), D-D ($p = 0.766$, $\eta_p^2 = 0.015$), C-B ($p = 0.511$, $\eta_p^2 = 0.030$), and V-A ($p = 0.540$, $\eta_p^2 = 0.028$) were not significant among the four different fragrance groups.

In Fig. 6, the psychological responses to the 15 pairs of emotional words that were provided in association with the inhalation of four peony fragrances were analyzed. The results revealed that all peony scents tended to elicit the positive emotions, although the participants did have different responses to different peony fragrances. Furthermore, participants felt more relaxed, pleasant, sweet, natural, calm, and warm in the presence of rose scent (RS), comparing to the other scents including phenolic scent (PS), woody scent (WS), and lily of the valley scent (LVS).

Discussion

The current study assessed the physiological and psychological effects of olfactory stimulation by peony flowers on human. Compared to the measurements for the control groups, autonomic nervous system parameters (HR, LF/HF, and HF) and POMS (T-A, A-H, F-I, D-D, C-B, and V-A) scores were determined to have significant changes after inhaling the four peony fragrances. These outcomes, showing that olfactory interaction with the peony fragrances could relax people and reduce stress, were similar to those found in previous studies [18, 20]. However, our results suggest that the differences among the four peony scents (PS, RS, WS, and LVS) were not significant. In addition, from the perspective of semantic difference scale, students' responses to the four scents of peony flowers were all positive. We conclude that the flower scents of different peony cultivars can induce optimistic emotions, and the rose scent is preferred by participants than the three others.

EEG is used to determine human comfort or stress by measuring brain functions. Basically, brainwaves are associated with a particular state of mind; for example, during relaxation, our brain starts producing alpha waves. In the present study, the theta, low alpha, and high alpha wave activities were significantly increased in the experimental (peony fragrance) groups than in the control (resting) groups. These results were consistent with the previous studies showing that plant essential oils (lavender oil, citronella oil) inhalation significantly increases the alpha wave power [13, 17]. Other studies have shown that alpha power increases when there is a feeling of happiness, and decreases when there is a feeling of sadness [27]. Furthermore, alpha waves dominate during quiet flowing emotions [28], and increased alpha wave activity indicates high relaxation [29]. Interestingly, drug addicts produce more alpha activities, which is a

common example of physical relaxation [30]. In addition, increased theta waves were observed during meditation and various situations [31]. Thus, we can know that inhaling the four peony scents enhances the relaxation level compared with the control groups. Similarly, the participants' low and high beta brain activities were higher after inhaling the peony fragrance, suggesting that participants were more active and alert. Increased beta wave activities were observed during the alert state of mind, whereas lower beta wave activities were observed during the drowsiness state [32]. Furthermore, beta waves occur when the individual is alert, externally focused and relaxed [33]. An increase in alpha and beta wave activities were found during relaxation techniques [34]. Thus, we conclude that olfactory stimulation by the four different peony scents makes participants alert and relaxed, but there was no significant difference in this study. In contrast, delta, low- and high-gamma wave activities were lower after inhaling the peony fragrance. Delta waves are the slowest waves and are produced during deepest meditation [33]. The previous studies have shown that an increase in gamma brainwave activities might be associated with a higher meditation state [35]. Therefore, olfactory stimulation of the four different peony scents might induce a light or general meditative state.

This study was the first one that investigated the relationship between the different types of tree peony fragrances and human physical and mental health. The study showed that robust finding for associations between inhaling the tree peony fragrance and physiological indexes and psychological scales. Compared with previous studies [18], this study combined heart rate variability and brain waves to comprehensively evaluate the physiological effect of peony flower fragrance on the participants.

It is worth mentioning that our research, differing from the previous [18, 36, 37, 38–41], has been completed initially by inhaling the four different peony scents. From the perspective of tree peonies application, we consider that the present study suggested three key implications. First, the four different peony scents could provide a positive effect on the participants. This indicated that the peony cultivars mentioned in this paper can be used as optimal plant materials for constructing peony fragrant landscape. Second, the essential oil, perfume, and essence can be extracted from tree peony petals [42, 43]. We suggest that the peony cultivars mentioned in this study can be used to develop the cosmetics and health care products. Finally, we suggest that the designers appropriately increase the application of tree peonies (e.g., peony cut flowers, peony pot flowers) in the indoor environment to create an aesthetic and health-promoting environment.

However, we must admit that the present study does have a few limitations. First, all of the participants were college students. We only evaluated the effects of tree peony fragrance on college students, so that the differences of the data for the psycho-physiological effects on various populations (e.g., office workers, elderly people, and patients) still remain unclear. Second, the lack of participants' personal information of confounding variables such as cultural background (e.g., peony culture researcher), and personality (e.g., peony aroma lover) potentially affects the accuracy and reliability of the experimental results. Additionally, the present study only used heart rates, HRV to demonstrate the autonomic nervous system parameters of participants. Other experimental indices, such as skin temperatures, respiratory

rates, and stress hormone concentrations, should also be assessed for a more comprehensive determination of the effect of olfactory stimulation by tree peony flowers on human physiology.

Similar to the smell of other plants in the landscape [44, 45], tree peony fragrance has health care function. As mentioned above, this may mainly benefit from some volatile components emitted by plants [2, 3]. Further, more insight is needed in the correlation between floral constituents (e.g., monoterpenol, monoterpene) of tree peony and psycho-physiological indexes. In addition, next to purposeful olfactory stimulation of flower fragrance, the plant culture may also contribute to mental health [46]. Tree peonies may also form the smellscape in the green spaces. Further research is needed to investigate the association between the cultural connotation of tree peony smellscape (e.g., smell metaphor, smell preference, smell memory, smell symbol) and mental health.

Conclusion

Our study revealed that olfactory stimulation by the four peony fragrances elicited a significant change in heart rates, sympathetic nerve activities, and parasympathetic nervous activities. The subjects displayed more positive emotions and preferred the rose scent. Moreover, the power of low alpha, high alpha, and theta brain activities was significantly increased, indicating a state of relaxation and meditation. We thus concluded that the participants could substantially benefit from the four peony scent inhalations in terms of body and mind.

Declarations

Ethics approval and consent to participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of College of Landscape Architecture and Arts, Northwest A&F University.

Consent for publication

Not applicable

Availability of supporting data

The dataset supporting the conclusions of this article is included within the article.

Competing interests

The authors declare that they have no competing interests.

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Author Contributions

R.-L.Z. contributed to the experimental design, data acquisition, statistical analysis, interpretation of results, and manuscript preparation. G.Z. contributed to preparing the experimental sites and cooperated in the data acquisition. B.-T.Z. and L.-N.G. participated in the data acquisition and contributed to the interpretation of the results. Y.-L.Z. and L.-X.N. conceived and designed the study, contributed to the interpretation of results, and the manuscript preparation. All authors have read and approved the final version submitted for publication.

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Abbreviations

PS: phenolic scent; RS: rose scent; WS: woody scent; LVS: lily of the valley scent; HR: heart rate; HRV: heart rate variability; LF: low frequency; HF: high frequency; POMS: Profile of Mood States; SDM: semantic differential methods; EEG: electroencephalography; D: delta, T: theta, LA: low alpha, HA: high alpha, LB: low beta, HB: high beta, LG: low gamma, and HG: high gamma; T-A: tension-anxiety; A-H: anger-hostility; F-I: fatigue-inertia; D-D: depression-dejection; C-B: confusion-bewilderment; V-A: vigor-activity

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Figures

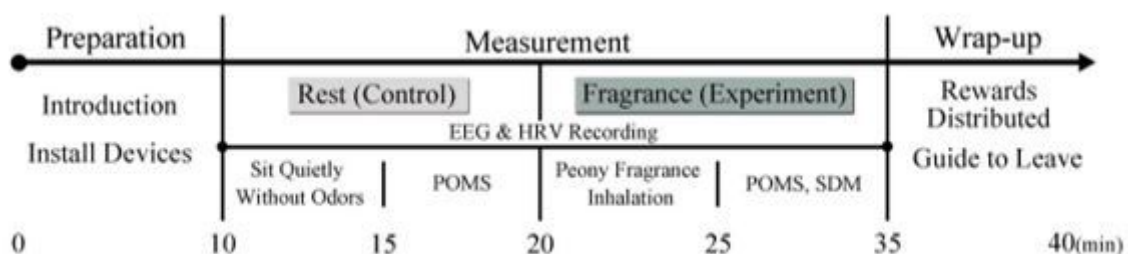


Figure 1

Sequence of associated experimental event.

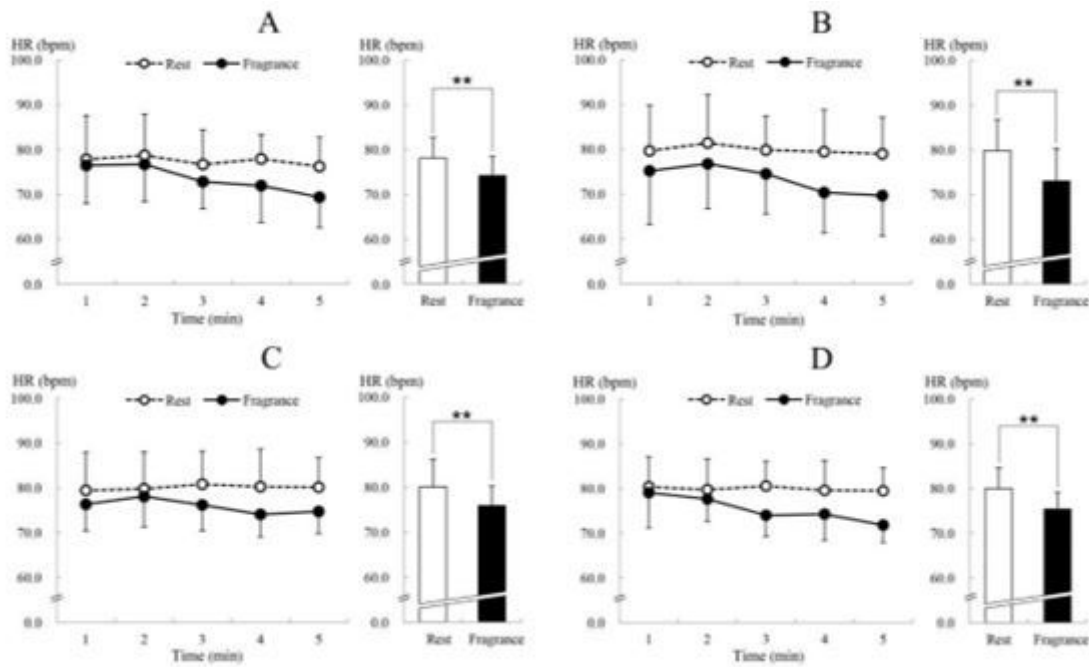


Figure 2

Changes in each 1-min heart rate values and overall mean heart rates between resting and peony fragrance. (A) phenolic scent, (B) rose scent, (C) woody scent, and (D) lily of the valley scent. HR: heart rate. N=20, mean±SD. **p < 0.01, paired-sample t test.

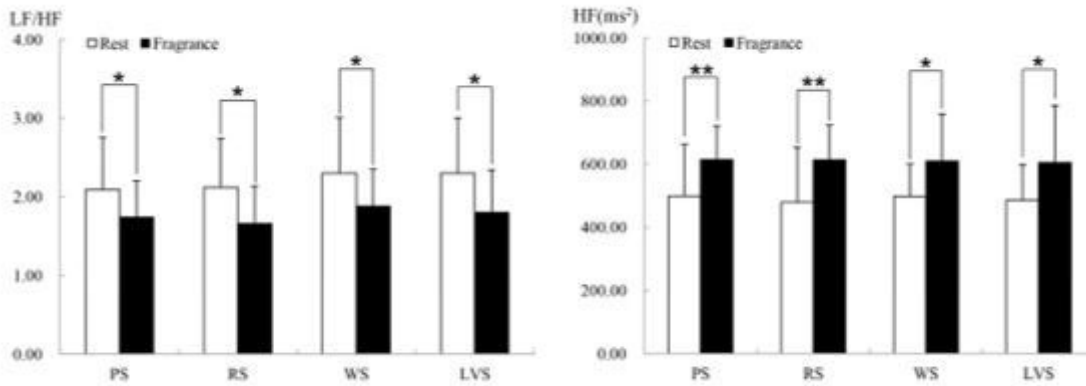


Figure 3

Comparison of high-frequency (HF) power levels and low-frequency (LF)/HF power levels ratios of heart rate variability between resting and peony fragrance. PS: phenolic scent, RS: rose scent, WS: woody scent, and LVS: lily of the valley scent. N=20, mean±SD. *p < 0.05, **p < 0.01, paired-sample t test.

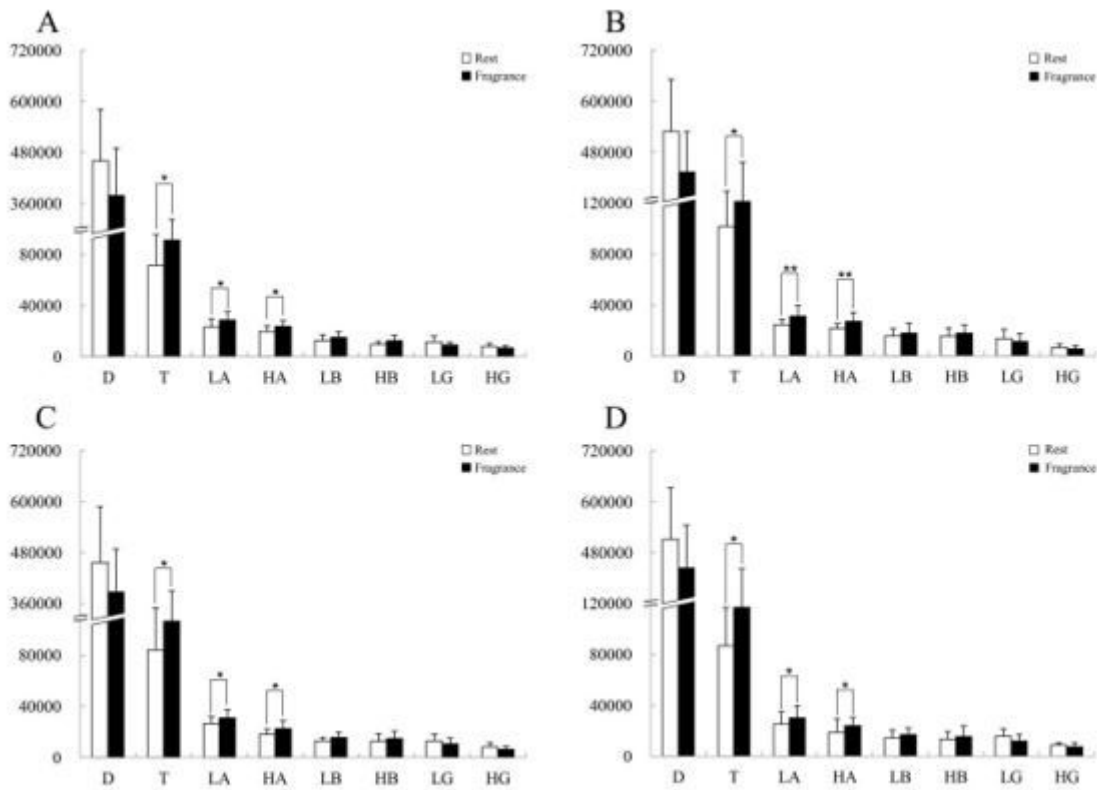


Figure 4

Comparison of the brainwave mean values between resting and peony fragrance. (A) phenolic scent, (B) rose scent, (C) woody scent, and (D) lily of the valley scent. D: delta, T: theta, LA: low alpha, HA: high alpha, LB: low beta, HB: high beta, LG: low gamma, and HG: high gamma. N=20, mean±SD. *p < 0.05, **p < 0.01, paired-sample t test.

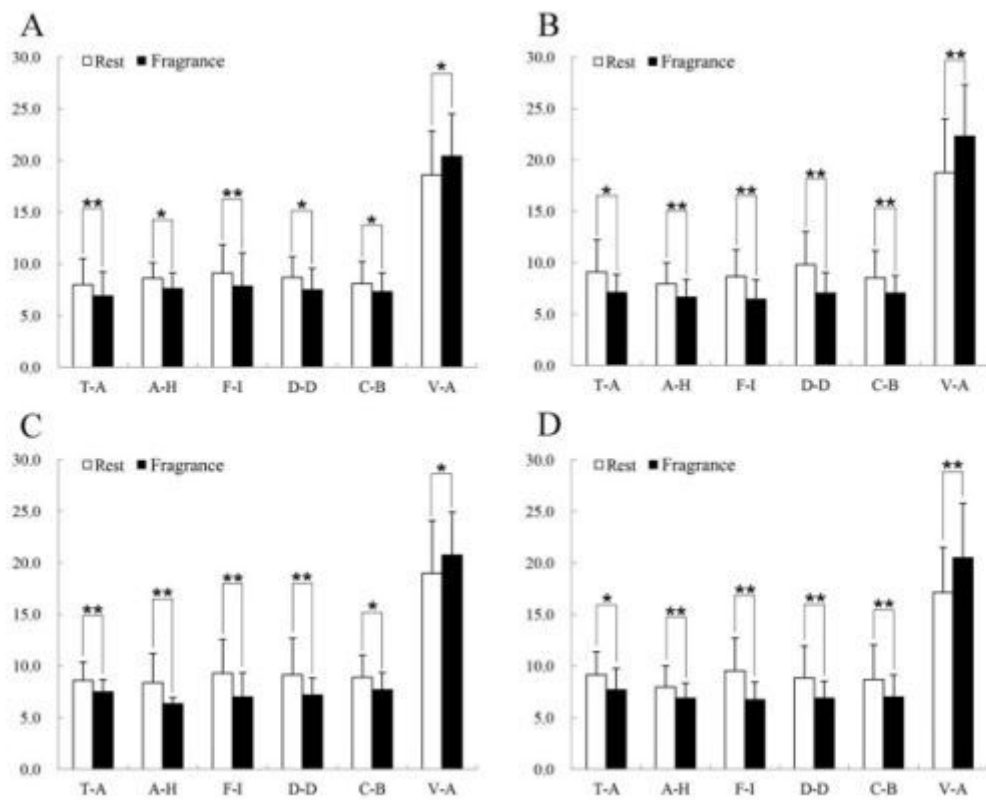


Figure 5

. Comparison of the POMS scores between resting and peony fragrance. (A) phenolic scent, (B) rose scent, (C) woody scent, and (D) lily of the valley scent. T-A: tension-anxiety, A-H: anger-hostility, F-I: fatigue-inertia, D-D: depression-dejection, C-B: confusion-bewilderment, and V-A: vigor-activity. N=20, mean±SD. *p < 0.05, **p < 0.01, paired-sample t test.

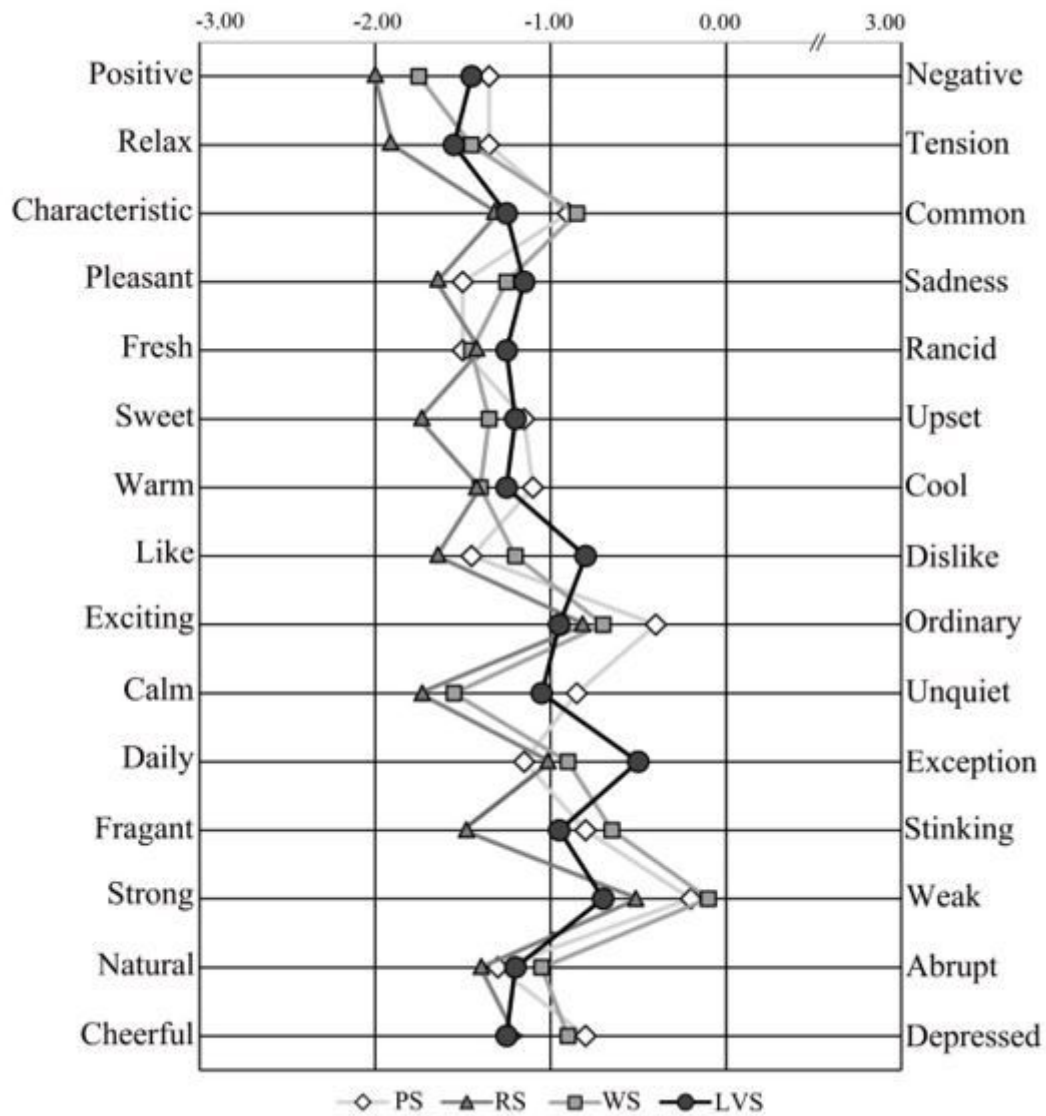


Figure 6

Impression evaluation of the four peony fragrances by the semantic differential scales. PS: phenolic scent, RS: rose scent, WS: woody scent, and LVS: lily of the valley scent.