

The Effects of Lavender Oil Inhalation on Emotional States, Autonomic Nervous System, and Brain Electrical Activity

Winai Sayorwan MPham*, Vorasith Siripornpanich MD**,
Teerut Piriyaupunayaporn BSc***, Tapanee Hongratanaworakit Dr rer nat****,
Naiphinich Kotchabhakdi PhD**,***, Nijisiri Ruangrunsi PhD*

* College of Public Health Sciences, Chulalongkorn University, Bangkok, Thailand

** Research Center for Neuroscience, Institute of Molecular Biosciences,
Mahidol University, Salaya, Nakhonpathom, Thailand

*** Salaya Stem Cell Research and Development Project, Research Center for Neuroscience, Institute of Molecular Biosciences,
Mahidol University, Salaya, Nakhonpathom, Thailand

**** Faculty of Pharmacy, Srinakharinwirot University, Nakhon-nayok, Thailand

Objective: Investigate the effects of lavender oil on the central nervous system, autonomic nervous system, and mood responses in humans after inhalation.

Material and Method: Twenty healthy volunteers participated in the experiments. The present study assessed autonomic parameters such as blood pressure, heart rate, respiratory rate, and skin temperature to determine the arousal level of the autonomic nervous system. In addition, subjects were asked to estimate their mood responses such as feeling pleasant or unpleasant, uncomfortable, sensuality, relaxation, or refreshing in order to assess subjective behavioral arousal. Finally, electroencephalogram (EEG) was recorded from 31 electrodes on the scalp according to the international 10 to 20 system, and EEG power spectra were calculated by Fast Fourier Transform (FFT). Data was analyzed by comparing the effects of lavender oil on physiological and mood states with sweet almond oil. These assessments were measured before and after using paired t-test statistical procedure.

Results: The results revealed that lavender oil caused significant decreases of blood pressure, heart rate, and skin temperature, which indicated a decrease of autonomic arousal. In terms of mood responses, the subjects in the lavender oil group categorized themselves as more active, fresher, relaxed than subjects just inhaling base oil. Compared with base oil, lavender oil increased the power of theta (4-8 Hz) and alpha (8-13 Hz) brain activities. The topographic map showed obviously more scattering power in alpha range waves particularly in bilateral temporal and central area.

Conclusion: The findings provided evidence the relaxing effect of inhaling lavender oil

Keywords: *Lavandula angustifolia* Mill, Physiological parameters, EEG, Relaxation

J Med Assoc Thai 2012; 95 (4): 598-606

Full text. e-Journal: <http://www.jmat.mat.or.th>

Aromatherapy can be defined as the use of essential oils to balance mind, body, and spirit. The word is derived from two words: aroma and therapy. "Aroma" means smell or fragrance and "therapy" means treatment. Complementary and alternative medicines usually use aromatherapy in their treatments by using essential oils usually derived from volatile liquid plant materials and other aromatic compounds from plants⁽¹⁾. In Thailand, lavender is a popular essential oil in aromatherapy and administered by inhalation or

massage. It is also the best-selling essential oil, particularly in Bangkok⁽²⁾.

Lavenders are members of a genus *Lavendula* and belong to the mint family, Lamiaceae, which is native to the Mediterranean. In general, the essential oil of lavender (*Lavendula angustifolia* Mill) consists of linalyl acetate, β -linalool, and β -caryophyllene⁽³⁾. The general properties of lavender oil are antibacterial, antifungal, carminative (smooth muscle relaxant), sedative, antidepressant, promoting wound healing, and increasing the detoxification of enzymes associated with insecticide resistance⁽⁴⁾. A number of researchers report the sedative effects of lavender oil caused by the major components linalyl acetate and β -linalool^(5,6). These compounds can be rapidly

Correspondence to:

Ruangrunsi S, College of Public Health Sciences,
Chulalongkorn University, Bangkok 10300, Thailand.

Phone: 0-2218-8158

E-mail: nijisiri.r@chula.ac.th

absorbed through the body by inhalation with plasma level reaching a maximum peak in approximately seven minutes after administration⁽⁷⁾, which can cause a depression of nervous system. Linalyl acetate has a narcotic action and linalool acts as a sedative^(5,6). Diego et al⁽⁸⁾ found that individuals felt more relaxed and an improved mood after inhaling lavender oil. Moreover, an increase of mid frontal (F3, F4) alpha power on their EEG was found after inhalation of the oil⁽⁸⁾. Motomura⁽⁹⁾ suggests that lavender has been demonstrated to decrease stress scores and increase Theta 1 (3.5-5.5Hz) brain wave activity and decrease Beta 1 (13.5-20 Hz) which is associated with relaxation. In contrast, Masago⁽¹⁰⁾ found that there was a partial decrease in alpha1 (8-11Hz) activity and a significant decrease in posterior temporal lobe activity after receiving lavender oil. Some researchers studying autonomic nervous system activity also showed contrasting results. For example, Tongnit et al⁽¹¹⁾ found a significantly decreased blood pressure, heart rate and respiratory rate caused by three minutes inhalation of lavender essential oils, whereas Sriboon⁽¹²⁾ found inhalation lavender oil by aroma lamp caused a significant decrease in respiratory rate and subjective calmness and relaxation, but diastolic blood pressure and heart rate increased. These results might be due to hedonic effect (pleasant and unpleasant). In the research by Brauchli et al⁽¹³⁾, they reported that heart rate is an autonomic variable that can be affected by pleasant and unpleasant oils. For example, valeric acid (judged unpleasant) can increase heart rate, while the heart rate decreases with phenylethyl alcohol (rated pleasant). Therefore, the differences between stimulant aromas and sedative aromas that can affect the pattern of heart rate are affected by two important factors, the characteristic of the essential oil and its pleasantness.

Many researchers studied the effect of lavender oil on the brain wave activity, the autonomic nervous system, and mood states⁽⁵⁾. However, these findings were often contradictory. Furthermore, some studies only investigated the activities in just two dimensions⁽¹⁰⁻¹²⁾. Investigations of the effects of lavender oil in the three dimensions of brain wave activity, the autonomic activity, and mood responses have rarely conducted. Consequently, the present study seems to be the first experiment to examine the effects of lavender on central nervous system, autonomic nervous system, such as heart rate, blood pressure, breathing rate, and skin temperature, and an assessment of mood states using an inhalation technique.

Material and Method

Subjects

Twenty selected participants equal number of male and female aged between 18 and 35 years (mean age 23.25 ± 4.52 years) with normal body mass indices (mean 20.86 ± 1.91) were enrolled in the present study. A summary of the demographic data of the participants is presented in Table 1. All participants were right-handed as determined by the Edinburgh Handedness Inventory⁽¹⁴⁾. None of the subjects had abnormalities affecting smell, cardiovascular diseases, or a history of smoking or drug addiction. Subjects were screened for a normal sense of smell using the n-butyl alcohol test method⁽¹⁵⁾ (mean score 10 ± 0.77). Twelve hours prior to testing subjects were asked to wash their hair without any spray. They were also asked not to use antiperspirants, perfumes and refrain from consuming alcohol, cigarettes, or caffeinated drinks. Women who were menstruating were not included in the sample⁽¹⁶⁾. They were requested to try to sleep well before the day of the experiment to avoid feeling fatigued or drowsy. Subjects 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.

The present study was approved by the Ethical Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University, Permissions No. COA NO.009/2011.

Essential oil administration

The oil of lavender was obtained from the Thai China Flavours and Fragrances Company. The oil composition was identified by gas chromatography/mass spectrometry (GC/MS) (Thermo Finnigan model Trace GC Ultra equipped with Finnigan DSQ MS detector, USA). The constituent of the oil were identified matching their mass spectra and retention times indicated with NIST05 MS library and the percentage compositions were computed from GC peak

Table 1. Demographic data for the volunteers

Parameters	n	Minimum	Maximum	Mean	SD
Age	20	18	38	23.25	4.52
Height (cm)	20	152	17	167.43	6.82
Weight (kg)	20	46	771	58.57	6.38
Body mass index	20	17.85	24.71	20.86	1.91
Smell test	20	9	11	10.00	0.77

area. Two main components of lavender oil comprised linalyl acetate (32.46%) and linalool (31.91%).

A one-milliliter mixture of either undiluted sweet almond oil or 10% (v/v) of lavender in base oil was delivered using an oxygen pump system through a plastic tube via respiratory masks in an inhalation set for adults that permitted selective routine air flow (2 L/min). Before the experiment, they were asked to inhale base oil and lavender oil to rate the pleasantness of the smell on a five-point Likert scale. The participants, who indicated oil pleasantness within the target level range of 2-4 were chosen to participate in the present study.

Autonomic nervous system (ANS) and mood measurement

Mood state and ANS parameters, blood pressure, heart rate, skin temperature, and respiratory rate, were recorded at the same time. The ANS parameters were measured using life scope 8 bedside monitors (Nihon Kohden, Japan). The assessment of mood state was based on the conceptual model proposed by the Geneva Emotion and Odor Scale (GEOS)⁽¹⁷⁾. This scale described their subjective affective feelings by a 100 mm visual analog scale based on the following five factors, pleasant feeling (feel good), unpleasant feeling (feel bad, uncomfortable, disgusted, frustrated, and/or stressed), sensuality (romantic), relaxation (relax, serene, and drowsy), and refreshing (refresh, energetic).

Electroencephalogram (EEG) recording

The set of 31 electrodes with 1 additional ground which was placed according to the international 10-20 system at FP1, FP2, FZ, F3, F4, F7, F8, FT7, FC3, FCZ, FC4, FT8, T3, T4, T5, T6, TP7, TP8, C3, CP3, C4, CZ, CPZ, CP4, P3, P4, PZ, O1, O2 and OZ. Both mastoids would be used as the recording reference (average of both mastoids, A1 + A2/2). The electro-oculogram (EOG) was monitored with four electrodes placed in both external canthi (HEOL and HEOR), left supraorbital (VEOU) and infraorbital (VEOL) regions. Electro-Caps are made of an elastic spandex-type fabric with recessed, silver/silverchloride (Ag/AgCl) electrodes attached to the fabric. Electrode impedances were set below five kOhms⁽¹⁸⁾. The recording system is Acquire Neuroscan version 4.3 (Neurosoft, INC). The online filter was set to a band pass with low pass is equal 70 Hz and high pass is equal DC. A/D rate was 500 Hz. Gain was set at 19. Notch filter was open at 50 Hz. The relative power

spectrum of the respective frequency bands derived by Fast Fourier Transformation (FFT) were expressed as follows: Delta (0-3.99 Hz), Theta (4-7.99 Hz), Alpha1 (8-9.99 Hz), Alpha2 (10-12.99 Hz) and Beta (13-30 Hz).

Procedure

An A-B design was used, so that each individual session consisted of two trials. This design was chosen because, with olfactory stimulation, the times course of stimulatory effects is unknown, which might make results obtained from other designs, such as A-B-A, difficult to interpret⁽¹⁹⁾. All experiments were conducted in a quiet room with ambient temperature ($24 \pm 1^\circ\text{C}$) and 40 to 50% humidity. The experiments were performed between 8.00 and 12.00 a.m. to minimize circadian variation. All participants attended to this research for two times, firstly, to measure the autonomic nervous system and mood change, secondly, to measure brain wave. Before ANS measurement beginning, the researcher clearly informed the procedure, then participants signed an Informed Consent Form describing the present study and their rights. In addition to ANS measurement, the ANS electrodes were attached to the appropriate positions; the ANS parameters, *i.e.* heart rate, skin temperature, and respiratory rate, were recorded at one-minute intervals. Systolic and diastolic blood pressure was recorded every five minutes. The tests consisted of three trials: first session served as a base line (resting period) and took ten minutes. After completion of the first session, subjects were asked to rate their mood state scales. The second and third session took 20 minutes each. In the second, the sweet almond oil was inhaled to the subjects, then mood state was measured after sweet almond oil inhalation. In the third trial, 10% (v/v) lavender oil in sweet almond oil was applied and mood state was measured after its inhalation. Participants were required to measure their brainwave again after the experiment no less than seven days. The EEG experimental conditions were the same as autonomic nervous system experiment. The experimental procedure was divided into four sessions of seven minutes each. Baseline EEG recording was done with both eyes opened and eyes closed respectively. After that participants would be inhaled undiluted sweet almond oil. Finally, 10% Lavender in sweet almond oil was inhaled.

Data and statistical analysis

The SPSS statistical package 17 was used for data analysis on the effects of lavender oil on

physiological and mood states in two steps before and after treatments by a paired t-test on blood pressure, heart rate, skin temperature, power of brain wave and rating of mood state. The respiratory rate was analyzed by the nonparametric Wilcoxon sign rank test. A p-value < 0.05 was considered significant. Mann Whitney U-test was performed to determine the gender different of physiological and mood effect.

Results

Autonomic nervous system parameters

The mean and Standard Deviation (SD) values of autonomic parameters in the experiment are presented in Table 2. The data were compared on various autonomic parameters during resting and inhaling sweet almond oil. Subjects had significantly

decreased heart and breathing rates (p-value < 0.05) during the sweet almond oil treatment compared with those of resting. Moreover, when subjects inhaled the lavender the systolic and diastolic blood pressures, heart rate and skin temperature were significantly decreased compared with sweet almond oil inhalation.

Mood state response

The mean and SD of mood state response are shown in Table 3. Subjects felt unpleasant when sweet almond oil was applied, with data showing decreased scores in good, active, fresh and relaxed feelings. After a lavender inhalation, subjects felt they had significant increases in pleasant emotions; good, active, fresh, and relaxed (p-value < 0.05). Furthermore,

Table 2. Mean and SD of ANS parameter change during resting, sweet almond oil and lavender

Parameters	n	Rest		SO		LO		p-value rest and SO (t-test)	p-value SO and LO (t-test)
		Mean	SD	Mean	SD	Mean	SD		
Systolic blood pressure (mmHg)	20	109.91	9.74	110.27	9.51	108.00	8.41	0.588	<0.001*
Diastolic blood pressure (mmHg)	20	69.32	8.76	70.26	8.96	68.52	8.43	0.527	<0.001*
Heart rate (bpm)	20	71.20	11.69	68.43	12.86	65.68	10.73	0.001*	<0.001*
Skin temperature (°C)	20	31.14	1.64	31.25	1.96	31.00	1.94	0.296	0.001*
Respiratory rate (bpm)	20	18.44	9.34	15.70	2.91	16.36	6.71	0.029*	0.148

* Significant difference, p-value < 0.05
SO = sweet almond oil; LO = lavender oil

Table 3. Mean and SD of emotional state change during resting, sweet almond oil and lavender

Emotion	n	Rest		SO		LO		p-value rest and SO (t-test)	p-value SO and LO (t-test)
		Mean	SD	Mean	SD	Mean	SD		
Good	20	61.50	11.20	50.05	17.22	73.15	14.78	0.010*	<0.001*
Bad	20	15.50	12.77	23.55	18.57	15.12	18.71	0.046*	0.085
Active	20	50.80	16.18	44.05	13.83	64.20	13.66	0.104	<0.001*
Drowsy	20	26.55	19.47	40.90	24.47	30.05	20.22	0.003*	0.047*
Fresh	20	53.45	12.68	43.35	11.12	59.40	18.18	0.004*	0.001*
Relax	20	59.15	20.97	51.55	19.26	73.65	21.41	0.243	0.004*
Stress	20	12.55	8.75	16.25	12.38	16.45	11.35	0.086	0.948
Uncomfortable	20	16.85	13.45	24.00	16.94	18.70	15.22	0.627	0.206
Romantic	20	28.78	17.43	31.35	22.86	40.55	24.38	0.709	0.151
Frustrated	20	12.51	10.15	16.40	14.77	16.55	18.38	0.094	0.976
Clam	20	62.00	18.96	54.85	19.98	61.60	20.18	0.112	0.276
Disgust	20	8.60	7.60	12.35	11.60	10.85	14.11	0.092	0.712

* Significant difference, p-value < 0.05
SO = sweet almond oil; LO = lavender oil

the bad and drowsy feelings were significantly decreased (p-value <0.05).

EEG data

The EEG power was calculated for each frequency band among resting, sweet almond oil, and lavender oil inhalation. The studied areas were divided into the left anterior (Fp1, F3, F7), right anterior (Fp2, F4, F8), right posterior (P4, T6, O2), left posterior (P3, T5, O1), and middle (Fcz, Cz, Cpz)⁽²⁰⁾ shown each band power with theta, alpha1, alpha2, Beta (Table 4) and expressed by topographic maps in Fig. 1. There were noticeable changes of band power in theta and alpha waves that significantly increased during the lavender inhalation in all brains areas (p-value <0.05). However, band powers in beta waves were not significantly different (p-value > 0.05, data not shown). The present study examined changes in the anterior, posterior alpha asymmetry (left and right side) response

to sweet almond oil and lavender. There was no significant asymmetry (p-value > 0.05) as Fig. 1. The topographic map shows obviously more scattering power in alpha brain, particularly in bilateral temporal and central area after smelling lavender compared with resting and sweet almond oil as shown in Fig. 2.

The analysis of male and female groups

Mean different score of autonomic nervous system, mood state and power of brain during lavender oil inhalation when compare to sweet almond oil from 10 male and 10 female group demonstrated that there were no significant change observed between both gender groups (p-value > 0.05, data not shown).

Discussion

In the present research, lavender oil was administered by inhalation to healthy subjects. Brain wave activity and ANS parameters (blood pressure,

Table 4. Mean power values in eyes closed during sweet almond oil and lavender

Area	Eye close (n = 20) mean	SO (n = 20) mean	LO (n = 20) mean	p-value eye close and SO (t-test)	p-value SO and LO (t-test)
Theta power (μV^2)					
Left anterior	1.91	1.54	2.16	0.590	0.001*
Right anterior	2.00	1.62	2.27	0.090	0.001*
Center	2.68	2.10	3.05	0.030*	0.006*
Left posterior	1.13	1.08	1.34	0.550	0.002*
Right posterior	1.15	1.10	1.38	0.025*	0.025*
Alpha1 power (μV^2)					
Left anterior	3.44	3.71	6.94	0.218	0.001*
Right anterior	4.02	4.38	7.70	0.218	0.001*
Center	4.78	4.83	9.40	0.156	0.001*
Left posterior	4.16	4.56	6.86	0.218	0.001*
Right posterior	4.29	4.46	8.79	0.001*	0.001*
Alpha2 power (μV^2)					
Left anterior	1.51	1.43	2.09	0.911	0.011*
Right anterior	1.63	1.50	2.23	0.575	0.006*
Center	2.28	1.96	3.09	0.179	0.003*
Left posterior	2.37	2.31	3.41	0.823	0.008*
Right posterior	2.76	2.51	4.10	0.002*	0.002*
Beta power (μV^2)					
Left anterior	0.31	0.35	0.33	0.167	0.351
Right anterior	0.32	0.36	0.35	0.156	0.433
Center	0.36	0.41	0.41	0.086	0.627
Left posterior	0.31	0.37	0.36	0.156	0.852
Right posterior	0.31	0.36	0.37	0.794	0.794

* Significant difference, p-value < 0.05
SO = sweet almond oil; LO = lavender oil

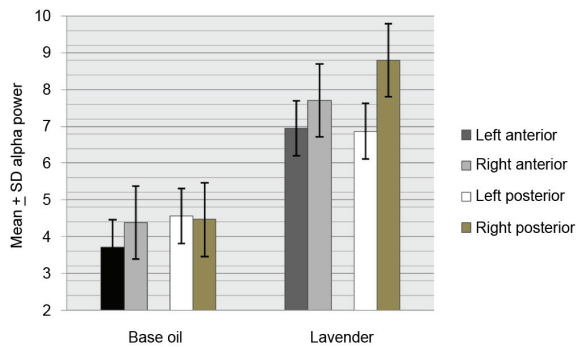


Fig. 1 The power of alpha activity showed no significantly different between left and right side of the brain

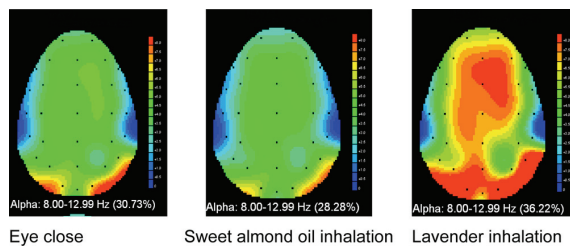


Fig. 2 Brain Topographical map of the distribution of alpha brainwave activity. The red areas indicate a significantly increase of power in bilateral temporal and central area during inhalation of lavender

heart rate, respiratory rate and skin temperature) were recorded as indicators of the arousal level of the nervous system. In addition, subjects had to rate their mood state in terms of good, bad, active, drowsy, fresh, relaxed, stressed, uncomfortable, romantic, frustrated, calm, and disgusted in order to assess subjective behavioral arousal.

Inhalation of lavender oil significantly decreased the level of ANS arousal, namely, decreases of blood pressure, heart rate, and skin temperature. These changes of the ANS parameters represent the function of parasympathetic nervous system that counteracts the function of sympathetic nervous system. As for mood states, subjects felt better, fresher, more active, more relaxed, and less drowsy. This finding points towards a decrease of arousal as assessed through subjective self-evaluation. The results of the present study support previous studies indicating lavender odor can influence relaxing

Previous studies using a footbath containing lavender oil also supports the positive effects on the parasympathetic neural activity of lavender oil⁽²¹⁾. To study the underlying mechanism of lavender oil on the

nervous system, its main component, linalool, is used as a compound to study its effects compared with plain lavender oil. It is noteworthy that Heuberger et al⁽²²⁾ found the reduction of blood pressure and skin temperature after applying linalool to the skin of participants. In addition, linalool has a lot of isoforms in nature such as R)-(-)-, (S)-(+)- and (RS)-(+)- forms. One study using R)-(-)-linalool found similar effects from this compound on the autonomic nervous system parameters and also promoted calming and feelings of vigor⁽²³⁾. According to the pharmacokinetic properties of linalool, Yamada⁽²⁴⁾ was able to show the lipophilic properties of the linalool was suitable for transporting this compound across the blood-brain barrier. When reaching the brain, linalool can bind with the GABA (gamma aminobutyric acid) receptors similar to the benzodiazepines and caused relaxing and sedative effects. In one study, they found linalool could potentiate the effects of GABA, the main inhibitor neurotransmitters of the human brain in the amygdala, the subcortical brain area involved in the emotional response to the environment⁽²⁵⁾. The effect of linalool on the amygdala may explain the mood effects of lavender.

It is felt the effects of lavender inhalation on the brain wave activities are well demonstrated in the present study. During inhalation with lavender, the power of theta (4-8 Hz) and alpha (8-13 Hz) activities are significantly increased in all brain regions. This result is consistent with the study of Diego⁽⁸⁾ that found after lavender inhalation that frontal alpha power was significantly increased. Furthermore, a study conducted at the University of Occupational and Environmental Health, Kitakyushu Japan⁽²⁶⁾ used changes of electroencephalogram (EEG) to measure the effects of aromas. The present study found relaxing effects with increases of alpha wave activities after administering lavender, cineol sandalwood, and alpha-pinene. The EEG evidence of relaxation can be seen in various practices such as meditation. Meditation is a way of balancing the body and the mind as well as controlling the mind to experience feelings of peace and relaxation. The study among people meditating can demonstrate similar EEG changes with lavender inhalation, which presented as an increase in theta and alpha activities in the brain during meditation⁽²⁷⁾. The increase in theta and alpha activities can also be observed even during pre-meditation states in people who frequently practice meditation⁽²⁸⁾. These results lend support that increases in theta and alpha wave activity causes a range of

general relaxation effects and can be induced by a range of chemical and non-chemical techniques⁽²⁹⁾.

The changes in physiological and mood state were not significant between males and females group. This might be the effect of control pleasantness of subjects before experiment. According to previous studies, the hedonic impact produced effects on the autonomic nervous system. However, to reduce hedonic impact bias, the participants were initially selected by measuring the degree of liking of each essential oil. They were asked to inhale base oil and lavender oil and to rate the pleasantness of the smell on a five-point Likert scale. The participants, who indicated odor pleasantness within the target level range of 2-4, were chosen to participate in the present study. The present study is relevant because previous research found that a significant change for left frontal differences in EEG were associated with the pleasant smells. By contrast, the unpleasant smells can also affect the brain on the right side⁽³⁰⁾. There was no difference in EEG between left and right side when feeling neutral to smells. Thus, according to the above studies, they suggested that the odor liking should be evaluated before the experiment, which could reduce the bias from the hedonic effect.

Conclusion

In conclusion, the present study explored the relaxing effects of inhaling lavender oil. The findings provided evidence that brain wave activity, autonomic nervous system response, and mood states were affected by lavender oil. The results lend some support for including lavender odor in medications aimed at blood pressure reduction and relieving depression or stress. For example, lavender oil decreases level of anxiety and improves mood in dental clinics⁽³¹⁾, after insomnia, women inhale lavender oil significantly improvement in sleep quality⁽³²⁾.

Acknowledgement

The authors wish to thank THE 90th Anniversary of Chulalongkorn University Fund (Ratchadaphiseksomphot Endowment Fund) and Herbal Remedies and Alternative Medicine Task Force of STAR: Special Task Force for Activating Research under 100 years Chulalongkorn University fund for the research grant supporting the present study. The authors wish to thank Dr. Chanida Palanuvej and Miss Thidarat Duangyod for GCMS protocol recommend and Dr. David Roberts for his editorial corrections.

Potential conflicts of interest

None.

References

1. Battaglai S. The complete guide to aromatherapy. 2nd ed. Brisbane, Australia: Watson Ferguson; 1997.
2. Patin R. The most commonly used essential oils for aromatherapy massage in Thai spa business [thesis]. Chiang Rai, Thailand: Mae Fah Luang University; 2007.
3. Hongratanaworakit T. Essential oil and aromatherapy. Bangkok: Witoonkanpok Press; 2008.
4. Cavanagh HM, Wilkinson JM. Lavender essential oil—a review. *Aust Infect Control* 2005; 10: 35-7.
5. Cavanagh HM, Wilkinson JM. Biological activities of lavender essential oil. *Phytother Res* 2002; 16: 301-8.
6. Re L, Barocci S, Sonnino S, Mencarelli A, Vivani C, Paolucci G, et al. Linalool modifies the nicotinic receptor-ion channel kinetics at the mouse neuromuscular junction. *Pharmacol Res* 2000; 42: 177-82.
7. Jirovetz L, Buchbauer G, Jager W, Raverdino V, Nikiforov A. Determination of lavender oil fragrance compounds in blood samples. *Fresenius J Anal Chem* 1990; 338: 922-3.
8. Diego MA, Jones NA, Field T, Hernandez-Reif M, Schanberg S, Kuhn C, et al. Aromatherapy positively affects mood, EEG patterns of alertness and math computations. *Int J Neurosci* 1998; 96: 217-24.
9. Motomura N, Sakurai A, Yotsuya Y. Reduction of mental stress with lavender odorant. *Percept Mot Skills* 2001; 93: 713-8.
10. Masago R, Matsuda T, Kikuchi Y, Miyazaki Y, Iwanaga K, Harada H, et al. Effects of inhalation of essential oils on EEG activity and sensory evaluation. *J Physiol Anthropol Appl Human Sci* 2000; 19: 35-42.
11. Tongnit K, Paungmalai N, Sukarnjanaset W. Investigation of physiological response to aroma. Special project in pharmacy, Faculty of Pharmacy. Bangkok: Chulalongkorn University; 2004.
12. Sriboon R. Comparison of stress reduction of aromatic volatile oil from holy basil (*Ocimum sanctum*) and lavender (*Lavender angustifolia*) in volunteers [thesis]. Chiang Rai, Thailand: Mae Fah Luang University; 2008.
13. Brauchli P, Ruegg PB, Etzweiler F, Zeier H. Electro cortical and autonomic alteration by administration of a pleasant and an unpleasant

- odor. *Chem Senses* 1995; 20: 505-15.
14. Hummel T, Mohammadian P, Kobal G. Handedness is a determining factor in lateralized olfactory discrimination. *Chem Senses* 1998; 23: 541-4.
 15. Cain WS. Testing olfaction in a clinical setting. *Ear Nose Throat J* 1989; 68: 316-28.
 16. Hummel T, Gollisch R, Wildt G, Kobal G. Changes in olfactory perception during the menstrual cycle. *Experientia* 1991; 47: 712-5.
 17. Chrea C, Grandjean D, Delplanque S, Cayeux I, Le Calve B, Aymard L, et al. Mapping the semantic space for the subjective experience of emotional responses to odors. *Chem Senses* 2009; 34: 49-62.
 18. Lorig TS. The application of electroencephalographic techniques to the study of human olfaction: a review and tutorial. *Int J Psychophysiol* 2000; 36: 91-104.
 19. Ilmberger J, Heuberger E, Mahrhofer C, Dessovic H, Kowarik D, Buchbauer G. The influence of essential oils on human attention. I: alertness. *Chem Senses* 2001; 26: 239-45.
 20. Iijima M, Osawa M, Nishitani N, Iwata M. Effects of incense on brain function: evaluation using electroencephalograms and event-related potentials. *Neuropsychobiology* 2009; 59: 80-6.
 21. Saeki Y. The effect of foot-bath with or without the essential oil of lavender on the autonomic nervous system: a randomized trial. *Complement Ther Med* 2000; 8: 2-7.
 22. Heuberger E, Redhammer S, Buchbauer G. Transdermal absorption of (-)-linalool induces autonomic deactivation but has no impact on ratings of well-being in humans. *Neuropsychopharmacology* 2004; 29: 1925-32.
 23. Kuroda K, Inoue N, Ito Y, Kubota K, Sugimoto A, Kakuda T, et al. Sedative effects of the jasmine tea odor and (R)-(-)-linalool, one of its major odor components, on autonomic nerve activity and mood states. *Eur J Appl Physiol* 2005; 95: 107-14.
 24. Yamada K, Mimaki Y, Sashida Y. Anticonvulsive effects of inhaling lavender oil vapour. *Biol Pharm Bull* 1994; 17: 359-60.
 25. Silva Brum LF, Emanuelli T, Souza DO, Elisabetsky E. Effects of linalool on glutamate release and uptake in mouse cortical synaptosomes. *Neurochem Res* 2001; 26: 191-4.
 26. Sugano H. Effects of odours on mental function. *Chem Senses* 1989; 14: 303.
 27. Takahashi T, Murata T, Hamada T, Omori M, Kosaka H, Kikuchi M, et al. Changes in EEG and autonomic nervous activity during meditation and their association with personality traits. *Int J Psychophysiol* 2005; 55: 199-207.
 28. Sutiwisesak R, Khampan W, Siripornpanich V, Sotthiwat U, Kotchabhakdi N. Electroencephalographical changes and topographic brain mapping in transcendental meditation. In: International Conference on Neuroscience Updates. Cochin University, Kerala, India; December 7-14, 2009: 57-8.
 29. Jacobs GD, Benson H, Friedman R. Topographic EEG mapping of the relaxation response. *Biofeedback Self Regul* 1996; 21: 121-9.
 30. Kline JP, Blackhart GC, Woodward KM, Williams SR, Schwartz GE. Anterior electroencephalographic asymmetry changes in elderly women in response to a pleasant and an unpleasant odor. *Biol Psychol* 2000; 52: 241-50.
 31. Lehrner J, Marwinski G, Lehr S, Jöhren P, Deecke L. Ambient odors of orange and lavender reduce anxiety and improve mood in a dental office. *Physiol Behav* 2005; 86: 92-5.
 32. Chien LW, Cheng SL, Liu CF. The effect of lavender aromatherapy on autonomic nervous system in midlife women with insomnia. *Evid Based Complement Alternat Med* 2012; 2012: 740813.

ผลของการสูดดมน้ำมันลาเวนเดอร์ต่ออารมณ์ความรู้สึก การทำงานของระบบประสาทอัตโนมัติ และคลื่นไฟฟ้าสมอง

วินัย สยอวรรณ, วรสิทธิ์ ศิริพรพาณิชย์, อธิษฐ์ พิริยะปัญญาพร, ฐานันท์ หงส์รัตนาวรกิจ, นัยพินิจ คชภักดี, นิจศิริ เรืองรังษี

วัตถุประสงค์: เพื่อทดสอบผลของน้ำมันลาเวนเดอร์ที่มีต่อระบบประสาทซึ่งแบ่งเป็นประสาทส่วนกลาง และประสาทส่วนอัตโนมัติ และการตอบสนองของอารมณ์ความรู้สึกหลังจากการสูดดม

วัสดุและวิธีการ: การศึกษาครั้งนี้อาสาสมัครสุขภาพดีจำนวน 20 คน การศึกษาครั้งนี้ทดสอบการเปลี่ยนแปลงในระบบประสาทอัตโนมัติโดยศึกษาการเปลี่ยนแปลง ของความดันโลหิต, การเต้นของหัวใจ อัตราการหายใจ และอุณหภูมิที่ผิวหนัง นอกจากนี้ยังศึกษาอารมณ์ความรู้สึกโดยแบ่งเป็นด้าน ได้แก่ ความชอบในกลิ่น, ความไม่ชอบในกลิ่น ความดึงดูดทางเพศ การผ่อนคลาย และความสดชื่น ในระบบประสาทส่วนกลางมีการศึกษาการเปลี่ยนของคลื่นสมอง โดยบันทึกคลื่นสมองทั้งหมด 31 จุดทั่วศีรษะ โดยบันทึกข้อมูลทั้งความถี่และค่าฟูเรียร์ทรานส์ฟอร์มอย่างรวดเร็ว ซึ่งข้อมูลเปรียบเทียบผลการเปลี่ยนแปลงทางสรีรวิทยา และอารมณ์ความรู้สึกเมื่อสูดดม น้ำมันลาเวนเดอร์ เทียบกับ สูดดมน้ำมันอัลมอนด์ โดยใช้สถิติ paired t-test

ผลการศึกษา: กลิ่นลาเวนเดอร์ทำให้ ความดันโลหิต การเต้นของหัวใจ และอุณหภูมิที่ผิวหนังลดลงเป็นการแสดงถึงการลดการทำงานของระบบประสาทอัตโนมัติ ในส่วนของอารมณ์ความรู้สึกอาสาสมัคร รู้สึกว่าตนเองมีความรู้สึกกระตือรือร้น รู้สึกสดชื่น และผ่อนคลายมากกว่าดมกลิ่นน้ำมันอัลมอนด์ นอกจากนี้ยังพบว่า มีการเพิ่มของคลื่นสมองประเภทบีต้า และแอลฟาอย่างเห็นได้ชัดเจน จากภาพถ่ายคลื่นสมองพบว่าสมองส่วน temporal และ central แอลฟาเพิ่มขึ้น

สรุป: ผลการศึกษาครั้งนี้สนับสนุนผลการการผ่อนคลายของการสูดดมน้ำมันลาเวนเดอร์
