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A Study about the Inhibition Effect of Jasmine Essential Oil on the Central Nervous System

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Abstract The purpose of this study was to understand the inhibition effect of jasmine essential oil on the central nervous system. The results of animal experiments revealed that the breath of jasmine essential oil could significantly delay the 1st and 5th levels of cramp-inducing time caused by pentetrazole. In human experiments, a multi-functional physiological recorder was utilized to investigate the change conditions of α brain wave activity, blood volume pulse, heart rate variability (HRV) (including low frequency (LF), high frequency (HF), normalized LF (nLF), normalized HF (nHF), LF/HF, standard deviation of normal to normal (SDNN)), muscle potential, skin conductance, respiration rate, peripheral temperature, and pain threshold. The experimental results indicated that after subjects breathed in the fragrant molecules of jasmine essential oil, the significant decreases in LF/HF, adjusted respiration rate and skin conductance, and the increasing trends of pain threshold values and peripheral skin temperatures were observed. However, the standard deviation results of α brain wave activity, muscle potential, low frequency power intensity, high frequency power intensity and normal-to-normal interval (NN interval) did not show any significant changes after subjects breathed jasmine essential oil. Furthermore, there were no apparent differences in the average heart beat and blood pressure after aromatherapy. After subjects breathed in the scent of jasmine, all their heart beats and blood pressures kept steady, which indicated that the individuals were under non- pressure condition. In addition, according to the results of relaxation relevant physiological signal alterations, breathing jasmine essential oil could inhibit central nerve system activity to make people feel relaxed. These characteristics of jasmine essential oil make it become a potential additional ingredient used in cosmetic composition. Perhaps breathing jasmine essential oil may become a new method for improving pressure type cosmetic problems in the further.

Keywords Jasmine essential oil, Multi-functional physiological recorder, Heart rate variability, Pressure, Cramp, Pain threshold value

1. Introduction

Essential oils have multiple pharmacologic activity for reducing body intenseness and mood pressure [1-4]. Additionally, essential oils can be used in disease prevention, including laxation, anti-depression, and reducing pain and anxiety [5, 6]. In mouse mode, long-term taking an essential oil orally can change neuronal transmission circuits, and obviously reduce anxiety and pain [7]. Furthermore, the frequencies of itching and grooming in mice can also be reduced after mice take an essential oil by mouth [8]. In human aromatherapy, essential oils have functions to soothe the nerves and treat anxiety disorder [9, 10]. Aromatherapy is the therapeutic use of essential oils, medicinal materials, flowers and other plants. The clinical researches of aromatherapy have been wide used to treat hypertension, depression, anxiety, Alzheimer's disease, and relax pain [11, 12]. Until now, however, there is no convincing evidence to demonstrate that aromatherapy is a kind of efficient treatment [11]. Therefore, in this study, a multi-functional physiological recorder was used to research the influence of jasmine essential oil therapy on relaxation effect, and it is hoped that this investigation can be applied to further improve and assess cosmetic problems caused by pressure in the further.

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2. Materials and Methods

2.1. Jasmine Essential Oil

Jasmine essential oil was purchased from H. Reynaud & Fils (Montgru-les-Bains, France), and the country of origin was Egypt.

2.2. Jojoba Oil

De-color and de-odor jojoba oil and dilution-used basal oil used in blank control group were purchased from Hsin Chien Hsing Co., Ltd. (Tainan, Taiwan).

2.3. Multi-Functional Physiological Recorder

2.3.1. Respiratory Channel

Respiratory channel was mainly used to detect thoracic respiration. A respiratory belt was fixed above the breast of a subject.

2.3.2. Electronic Hemadynamometer (TERUMO ES-P360, Japan)

When a subject was tested, a blood pressure cuff was placed on the left arm (2~3 cm above the elbow joint), the connecting line was in alignment with the center line within the arm, and the center of the palm was facing upward. In addition, any pressing and constrained matters could not be placed on the arm during the testing period, and diastolic and systolic pressures were recorded respectively.

2.3.3. Algometer (Takei Kiki, Japan)

An algometer was lightly placed on the inside of subject's left wrist. Pressure was exerted slowly and steadily from up to down, and was stopped until the subject showed pain response, which was pain threshold value.

2.4. Subjects

The sampling targets, including 15 male and 16 female, were from Taichung City, Taiwan. They were all over 18 years old, did not have a medical history of dysosmia, cardiovascular disease, epilepsy, and mental disorder, and did not take sedatives or sleeping pills recently. The testers did not be divided into different experimental groups, and the differences in means of data values were compared.

2.5. Research Method

The test schedule was arranged, and the subjects were tested individually regardless of age and group. Before test, the subjects were not told about the types of essential oil, and the result of relaxation or suppression induced by the essential oil in order to avoid interrupting subjects by the subjective consciousness of investigators [10]. When the experiment was been proceeding, the subject lay flat and supine, and was connected with a multi-functional physiological recorder. A detecting pole piece was fixed on the subject, and sensory pain threshold testing started to be examined when the detected values entered steady state. During sensory pain threshold testing, the subject was demanded to close the eyes in order to reduce the effect of psychological expectation on pain threshold values, and then the blood pressure was detected. After the detections of pain threshold values and blood pressure completed, 0.5 ml no color and no odor jojoba oil (blank control group of jasmine essential oil experiment) was breathed by the subject, and the physiological feedback data were collected for 5 minutes at the same time. Among 5-minute data, 3-minute usable data were used for the statistical section of experimental results in the blank group. Then 0.5 ml of 2% jasmine essential oil (experimental group) was also breathed by the subject. The physiological feedback data were collected for 5 minutes, and 3-minute usable data were used for the statistical section of experimental results in the experimental group. After the experiment, the subject was asked about the fragrance preference of jasmine essential oil, and the description was recorded. After the experiment was finished, the electrodes were cleaned with alcohol pads and prepared for the next experiment in order to avoid data pollution. Before the next experiment, the remaining odor in the room should be checked and removed, and the airiness should be kept.

2.6. Animal Experiment

The aim of animal experiment was to investigate whether jasmine essential oil has the same inhibition function of central nervous excitement as succinic acid [4, 11]. Eight-week-old ICR male mice with an average weight of 34.2±5.7 g were bought from BioLasco Taiwan Co., Ltd. A breeding unit consisted of 7 mice, which were bred in the same nest box. The temperature was controlled at 24±1°C, and 12 hours were a unit of light period (the lights were turned off for 12 hours and turned on for 12 hours). In jasmine essential oil experiment, ICR mice were divided into two groups. In the experimental group, a fixed amount of jasmine essential oil (2 ml) was placed in the nest box for mice to breathe every day. In contrast, mice in the negative control group did not smell any scent. After 14 days, mice in both groups were injected with 2% pentetrazole (PTZ) for doing inducing cramp experiment. Before inducing cramp experiment, the body weights of mice were measured first, and then a single subcutaneous injection of PTZ was offered according to the body weight of mouse. After the experiment was finished, and cramp-inducing level and time were compared according to the photography results. Mice in the negative control group did not smell any scent for 14 days, and then they were injected with succinic acid (400mg/kg) and physiological salt solution. After the mice were left for 30 minutes, PTZ-inducing cramp experiment was started, and then cramp-inducing level and time were compared according to the photography results.

2.7. Estimation of Cytotoxicity

The in-vitro cytotoxicity of the jasmine essential oil was determined by MTT (3-(4,5-dimethylthiazol-2-yl)-2,5 -diphenyltetrazolium bromide) assays [13]. L929 fibroblast cells (5000–6000) in 200 μL media per well were plated in a 96-well plate for 24 h to allow the cells to attach and then exposed to different concentrations of the jasmine essential oil for 24 h in 5% CO_2 at 37°C. At the end of the incubation time, the medium containing the jasmine essential oil was removed and MTT solution (20 μL, diluted in a culture medium to a final concentration of 5 mg/mL) was added. After incubation at 37°C in the dark for 4 h, 100 μL of DMSO was added to each well, and the absorbance was monitored with a microplate reader at a wavelength of 570 nm. Averages and standard deviations were based on four samples, and all tests were performed in triplicate. Percent survival was calculated as the percentage absorbance of the treated wells relative to the untreated wells ± S.D.

2.8. Estimation of Nonselective Toxicity

Estimation of nonselective toxicity of jasmine essential oil was determined by means of nonselective toxicity kit assay [14].

Different concentrations of jasmine essential oil (10 μL) and 10 μL of distilled water (blank control) were added to 96-well plates, and then 200 μL of non-selective toxicity detecting agent was added to each well and mixed well for 30 seconds at 37°C. The absorbance was detected by an ELISA microplate reader at a wavelength of 405 nm, and the resulting data were recorded against control. Each experiment was carried out for at least three times.

2.9. Statistics

The data from multi-functional physiological recorder were analyzed by SPSS 13.0 software. Results are given as the mean ± SE in perfusion units for each point measured. Student's t-test and ANOVA were used to calculate differences between two groups. Probabilities of 0.05 were considered statistically significant.

3. Results

3.1. Effect of Jasmine Essential Oil on Physiology of Subjects

A total of 31 people, including 15 male and 16 female, with an age range of 18-72 years were enrolled in this study. Most of them could accept this fragrance (like 23%, either like or dislike 64%), however, minority people (13%) felt unhappy. There was no relationship between gender and preference of jasmine fragrance ($\chi2=0.111$, $p=0.946$). Before jasmine essential oil breathing experiment, the physiological data of 31 subjects were collected by a multi-functional physiological recorder. The comparisons between pre-data and post-data of jasmine essential oil breathing experiment are shown in Table 1. The experimental results revealed no significant differences in heart beat, diastolic pressure, and systolic pressure between pre-data and post-data ($p>0.05$). However, all of sensory pain threshold, respiration rate, peripheral finger temperature, skin conductance, and LF/HF ratio presented significant differences ($p<0.05$). Then physiological relaxation index research results were analyzed using regression analysis in order to confirm the relevant levels among parameters, and the analysis results are shown in Table 2. Table 2 indicates that the correlation coefficient between heart beat and LF or HF was 0.74, which revealed a highly positive correlation. When sympathetic and parasympathetic nervous activity rose, heart beat also increase. Furthermore, the highly positive correlation ($r=0.94$) between the LF value and the HF value signals that the effect of aromatherapy is in position to stimulate sympathetic nerve and parasympathetic nerve at the same time. Besides, there is very highly positive correlation ($r=0.81$) between the LF value and SDNN. The data is consistent with the results in literature [12].

Table 1. The Physiological Statistic Values of Each Relaxation Effect in the Results of Jasmine Essential Oil Sniff Experiment

Relaxation Indicator	Results of Experiment		P Value
HF power (ms^2)	Pre	190.44 ± 273.31	0.29
	Post	308.23 ± 672.15	
LF power (ms^2)	Pre	162.74 ± 202.52	0.54
	Post	252.95 ± 799.15	
nHF	Pre	0.50 ± 0.17	0.06
	Post	0.55 ± 0.17	
nLF	Pre	0.50 ± 0.17	0.06
	Post	0.45 ± 0.17	
LF/HF power	Pre	1.71 ± 1.74	0.05
	Post	1.19 ± 0.91*	
SDNN (ms)	Pre	46.23 ± 22.78	0.09
	Post	56.68 ± 38.62	
Heart Beat (bpm)	Pre	73.86 ± 11.83	0.53
	Post	73.55 ± 12.05	
EMG C (μv)	Pre	198.59 ± 402.28	0.15
	Post	198.59 ± 402.28	
EMG D (μv)	Pre	266.49 ± 442.01	0.19
	Post	323.23 ± 475.36	
Temp. (°C)	Pre	33.48 ± 1.84	0.009
	Post	34.11 ± 1.45**	
Resp. Rate (breaths/minute)	Pre	15.77 ± 1.82	0.02
	Post	15.22 ± 2.16*	
Skin Conductance (μS)	Pre	1.48 ± 2.12	0.05
	Post	1.21 ± 1.51*	
Pain Threshold	Pre	2.86 ± 0.71	0.002
	Post	4.40 ± 1.77**	
Systolic Pressure (mmHg)	Pre	119.32 ± 14.93	0.26
	Post	118.23 ± 15.43	
Diastolic Pressure (mmHg)	Pre	71.94 ± 10.31	0.53
	Post	72.45 ± 10.39	
α power	Pre	1.18 ± 1.42	0.17
	Post	1.60 ± 2.98	

*p<0.05, **p<0.01; Pre represents before receiving relaxation therapy, Post represents after receiving aromatherapy relaxation experiment

Table 2. The Correlation Coefficient Matrix of Relax Index Variance

Correlation matrix	ΔHeart beat	ΔLF power	ΔHF power	ΔnLF	ΔnHF	ΔLF/HF	ΔSDNN	ΔTemp.	ΔResp. rate	ΔSC	ΔPain threshold
ΔHeart beat	1.00	0.74	0.74	0.23	-0.24	0.21	0.64	0.21	0.14	0.05	-0.18
ΔLF power	0.74	1.00	0.94	0.39	-0.40	0.19	0.81	-0.10	0.13	0.17	-0.05
ΔHF power	0.74	0.94	1.00	0.16	-0.17	0.11	0.86	-0.07	0.02	0.03	-0.06
ΔnLF	0.23	0.39	0.16	1.00	-1.00	0.56	0.20	-0.11	0.22	0.11	-0.07
ΔnHF	-0.24	-0.40	-0.17	-1.00	1.00	-0.56	-0.21	0.11	-0.22	-0.11	0.07
ΔLF/HF	0.21	0.19	0.11	0.56	-0.56	1.00	0.18	0.01	0.11	-0.11	-0.10
ΔSDNN	0.64	0.81	0.86	0.20	-0.21	0.18	1.00	-0.15	0.05	0.08	-0.11
ΔTemp.	0.21	-0.10	-0.07	-0.11	0.11	0.01	-0.15	1.00	-0.21	-0.09	-0.20
ΔResp. rate	0.14	0.13	0.02	0.22	-0.22	0.11	0.05	-0.21	1.00	0.34	0.04
ΔSC	0.05	0.17	0.03	0.11	-0.11	-0.11	0.08	-0.09	0.34	1.00	0.03
ΔPain threshold	-0.18	-0.05	-0.06	-0.07	0.07	-0.10	-0.11	-0.20	0.04	0.03	1.00

3.2. Jasmine Essential Oil Inhibits Mice Spasm Caused by Pentylenetetrazol

Picked mice separately from experimental group (2ml jasmine essential oil were given to sniff every day n=10) and blank control group (without being given any odor, n=10) and after weighing, they were give the same dose of spasmogen pharmacy PTZ (2%) to induce spasms. The results of observation of the level and time of the spasm induce d within 30 minutes are shown as Table 3. Comparing to the control group in which the mice were given 2ml jasmine essential oil, the spasm induced time was delayed for 37.2 seconds while the time for inducing grade five spasm was delayed for 84 seconds.

Table 3. The Results of Induction Time of Jasmine Essential Oil and Blank Control Group in PTZ Spasmogen

	Induction Time (minute)	
	Grade I	Grade V
Blank Control Group	1.99 ± 0.33	3.76 ± 0.87
Jasmine Essential Oil Group	2.61 ± 0.63*	5.16 ± 0.77**
Delayed Time	37.2 ± 42.7 (sec)	84.0 ± 69.7 (sec)

*p<0.05, **p<0.01; n=10

3.3. The Toxicity of Jasmine Essential Oil

The cell viability was determined by MTT test, suggesting IC50, 0.077 %v/v jasmine essential oil was not cytotoxic [14]. With 1mg/ml, the jasmine essential oil has no nonselective toxicity [14].

4. Discussion

4.1. The Physiological Change of the Subjects by Aromatherapy

4.1.1. The Effects of Aromatherapy on Heartbeat

The literature pointed out, under the status of relax, the heartbeat rate may insignificantly reduce [15-18]. The comparisons of the numbers of heartbeat before and after the therapy among 31 subjects found that the effects of the jasmine essential oil on the number of heartbeat were inclined to positive emotion. The differential values among individuals before and after aromatherapy with jasmine essential oil were relatively high (the differential value before experiment was 11.8bpm whereas after experiment was 12.1bpm). That indicated that the differential between group caused by the short-term effects of jasmine essential oil on human body might be related with cardiopulmonary function, gender and age [12, 17, 19].

4.1.2. The Effects of Aromatherapy on HRV

From Table 1, we could learn that in the changes of HRV caused by aromatherapy, only LF/HF power is significantly different in the statistics. Comparing to parasympathetic activity, sympathetic activity is inclined to weaken. Furthermore, from the correlation coefficient matrix in Table 3, we found that the variances of LF and HF were highly positively correlated in the study. Therefore, sniffing jasmine essential oil can simultaneously activate sympathetic and parasympathetic nerve activities in which the increment of parasympathetic nerve is greater that the LF/HF which is in overall balance may be lower and in turn, achieves the results of relax. Different from sniffing sandalwood, chamomile essential oil achieves the purpose of relaxation through enhancing parasympathetic nerves [20-21].

4.1.3. The Variation of Peripheral Temperature before and after Aromatherapy

Skin is closely related with partial blood flow, any factor that could affect skin vasomotor (such as the changes of ambient temperature or mental stress) could change the temperature on the skin [22-24]. Stimulated by the stress, the vessel wall will contract and peripheral blood flow reduces that the temperature of body extremities (fingers, toes) will be lower. On the contrary, in relax, the blood vessels will dilate that allows more blood pass through and peripheral temperature will rise. After receiving jasmine aromatherapy, in five minutes, both peripheral blood flow and the temperature on skin increase.

4.1.4. The Variation of Respiratory Rate before and after Aromatherapy

The respiratory training is one of the means of relaxation training. It achieves the purpose of promoting physiological relaxation through feedback caused by individual's spontaneous adjustment of respiratory frequency. During jasmine aromatherapy, the subjects' respiratory center will be micro-regulated that results in the slowing down of their respiratory frequency. So we could conclude that the adoption of aromatherapy of jasmine essential oil is helpful to the passive regulation of respiratory center and the production of the feeling of relaxes.

4.1.5. The Variation of Skin Conductivity before and after Aromatherapy

In the aromatherapy of jasmine, the subjects' secretion of sweat will reduce. Sweat glands are regulated by the sympathetic nerves that one is nervous or feel oppressed, his sympathetic nerve will stimulate sweat glands to increase the sweat [12, 25]. Similarly, in the stationary state, after receiving aromatherapy, the subjects's skin conductity is inclined to reduce that means the secretion of sweat is inhibited after aromatherapy, that is, because the sympathetic activity is also relatively lower [26].

4.1.6. The Variation of Perceived Pain Threshold before and after Aromatherapy

The pain receptors exist in the free nerve endings of human body and other tissues and are widely distributed in the surface layer of the skin the many internal tissues [27]. Although there are pain receptors in deep tissues, the density of the distribution is lower. The pain receptors can receive three different stimuli including mechanical, chemical and temperature stimuli. In addition to physiological mechanisms, the pain is also controlled by psychological and social factors that will affect individual's cognition and response to pain. The subjects who have received the jasmine aromatherapy are prone to slow down the feeling of pain and comparing to the those who did not sniff jasmine essential oil, they are not prone to perform without pressure. The previous research pointed out that the degree of pain soothing by aromatherapy was related to individual experiences, feeling and training [28]. The function of enhancement of perceived pain threshold by jasmine essential oil indicates that the jasmine essential oil may take good susceptibility of individual experiences and tainableness in the training of physiological feedback.

4.2. Correlation Coefficient Matrix of Relaxation Index Variance

Regarding the equilibrium indicator if sympathetic and parasympathetic nerves LF/HF, nLF value and LF/HF value are moderately positive correlation (r=0.56) whereas nHF value abd LF/HF value are moderately negative correlation (r=-0.56). That indicates that the jasmine essential oil activate at the same time sympathetic and parasympathetic activities. So under the enhancement of overall performance value, we could still see the equilibrium state of autonomic nerves from the rise of equilibrium indicators. HF power that symbolized the activities of parasympathetic nerves and LF power that symbolized the activities of sympathetic nerves were highly positive correlation (r=0.94). The equilibrium indicator, LH/HF value, of the subjects was inclined to be on the downside after the experiment. After comparing the correlation coefficient of LF/HF, nLF and nHF values, we could infer that after jasmine aromatherapy, both sympathetic and parasympathetic nerves could be stimulated at the same time and the increment of parasympathetic nerves activity was bigger while the autonomic nerves while the equilibrium indicator, LH/HF value, of autonomic nerves was lower. Such results could be considered as the inclination of relax. Comparing the stable situations of heartbeat numbers and blood pressure of the subjects before and after experiment, we could learn that jasmine essential oil can regulate the balance of autonomic nerves and result in the relaxation by strengthening the activity of parasympathetic nerves and such result of relaxation would not affect the normal operation of blood pressure and heartbeat.

5. Conclusions

The relaxation therapy through jasmine essential oil may affect center nervous system and cause similarly positive emotion colors that help the parasympathetic nerves of subjects better activated than sympathetic nerves. Furthermore, it has effects of physiological activity that short period of use could achieve the purpose of relaxation. Used as a cosmetic, in addition to the known antibacterial effect, it could achieve relaxation or strengthen the effects of relaxation through stabilizing center nerves and removing the feeling of stress by easing the way in therapy.

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