



Effect of Scent of Peppermint on Work Efficiency

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Abstract

This study was designed to clarify whether scent of peppermint influence the work efficiency. Twenty healthy females participated in this study (21.5 ± 0.7 yrs.). The Psychomotor Vigilance Test (PVT) was applied to the participants for 10 minutes in the room with peppermint oil or without the scent (control) to evaluate objectively the work efficiency. Reaction time (RT) to visual stimulation in PVT was applied for evaluation of work efficiency. Visual Analogue Scale (VAS) was also used for subjective sensation. These experiments were performed in different 2 rooms and the order of measurement was at random. This study was submitted to and approved by Ethic Committee of Ehime University Graduate School of Medicine. Mean of RT was 264.6 ± 36.5 msec or 247.9 ± 32.8 msec in control or in peppermint oil, respectively, and the mean RT of peppermint oil was significantly smaller. VAS showed 42.8 ± 17.1 for control and 68.8 ± 18.9 for peppermint, and there was a significant difference between two groups. These results indicate that the work efficiency must increase by smelling the scent of peppermint oil. When or before workers feel tired, inhaling the scent of peppermint may be able to change their mood followed by increasing the work efficiency.

Keywords: Psychomotor Vigilance Test, Peppermint oil, Sustained attention.

Introduction

Many people use essential oils or other herbs to alleviate anxiety, tension and fatigue in modern stressful society. In daily use, the easiest way is to drink as herbal tea or to enjoy the scent of essential oils. Various oils are used depending on the purpose, and there are many reports concerning essential oils. Previous studies have showed that lavender fragrance, one of the most commonly used oils, improves the quality of sleep in postpartum women [1] and reduces the level of salivary cortisol [2], serum cortisol [3], increases blood flow, decreases galvanic skin conductance and blood pressure [4], increases α wave in EEG [5]. Furthermore, using scents of orange and lavender is helpful in reducing anxiety in dental patients [6].

In contrast, the previous study using pupillary fatigue oscillations as an objective index reports that peppermint oil can reduce daytime sleepiness [7]. Another study reports that inhaling the minty odor has the promoting effect on recovery from the mental stress evoked by mental arithmetic calculation [8]. Thus, some essential oils have refreshing effect and the quality of life will be expected to improve by using different oils depending on the situation in daily life.

In general, sleepiness reduce sustained attention and also work efficiency. Therefore, it seems that the work efficiency would be improved if the sustained attention would increase by using the essential oil. Psychomotor Vigilance Task (PVT) is widely used as some methods to objectively measure attention and persistence [9, 10], and the degree of sleepiness [11, 12].

The purpose of this study was to examine whether the scent of peppermint is effective for sustained attention using PVT, followed by improvement of work efficiency.

Materials and Methods

Subject

Twenty healthy female volunteers (21.5 ± 0.7 yrs.), who understood the purpose of this study and obtained consent, participated in this study. They had no abnormal senses of smell and vision and did not take any medicines that may affect the nervous system. Furthermore, they were prohibited from eating and drinking other than water and from strong exercise for 2 hours before the experiment.

Evaluation of the sustained attention

Objective indicator

Psychomotor Vigilance Task (PVT) was used as an objective indicator of sustained attention using PVT Monitor (PVT-192, A.M.I, NY). **Figure 1 shows** a device to measure PVT used in this study. When the measurement starts, a number will be displayed in the top window. The numbers are continuously displayed as 1, 2, 3...and the subjects push the lower right button as soon as the number starts to appear.

When they push the button, the number that continued to be displayed stops, this is the reaction time. Namely, the reaction time (RT) to visual stimuli was evaluated as an objective sustained attention. The interstimulus interval, defined as the period between the last response and the appearance of the next stimulus, varied randomly from 2 to 10 seconds based on previous studies [11, 12, 13]. Furthermore, false starts (reaction time less than 100 milliseconds, hereinafter called msec) and errors (reaction time exceeding 500 msec) were excluded from analysis.

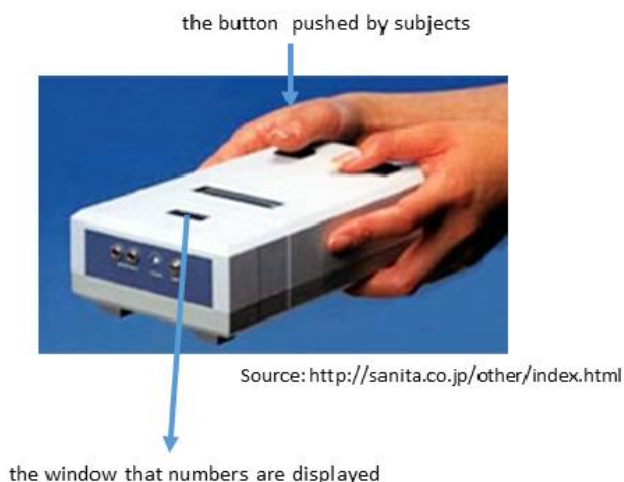


Figure 1: A device to measure PVT.

Subjective indicator

As a subjective index, Visual Analog Scale (VAS) was used, and 0 was defined that the subjects could not concentrate at all, and 100 that they could concentrate very much.

Essential oil used and usage

Peppermint oil (*Mentha pipertia* LaFleur, Biken CO., LTD., Tokyo) was used with a diffuser (Aroma diffuse ETERNITY MINI, ADF12-JWM, LADONNA.CO., LTD., Tokyo). 0.2 mL of essential oil, 4 drops, were dropped on an oil pad with a diameter of about 3.5 cm in the diffuser. There was a miniature bulb and a small fan under the oil pad, which warmed the oil and the scent of oil diffused into one experimental room. About 30 minutes before the start of experiment, the diffuser was activated to fill an experimental room with the scent of peppermint.

Experimental protocol

Experiment was carried out at 2 quiet experimental rooms with air conditioning (room temperature $25.1 \pm 0.6^\circ\text{C}$, humidity $30.2 \pm 2.3\%$). One room was used for a control group with no scent, and another was under the scent of peppermint. After the subjects entered an experimental room with no scent, they were explained how to use PVT and practiced for 1 minute. Following that, measurement started. PVT was performed for 10 minutes in a room filled with the scent of peppermint or without the scent (1st trial). After finishing one measurement, they moved another experimental room and measured in the same way (2nd trial). It took 2-3 minutes between first trial of PVT for 10 minutes and second trial. The order of the experimental conditions with or without the scent was performed in random order by the subjects. After the measurements under both conditions were completed, a subjective evaluation was conducted using VAS (Figure. 2).

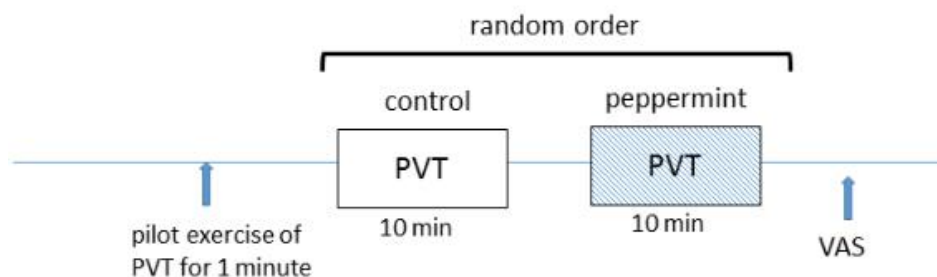


Figure 2: Experimental protocol.

Statistical analysis

The average value of RT in PVT for 10 minutes in each subject was used for analysis for the RT of PVT. Data was shown as mean and standard deviation. When the measured values in each group, control or peppermint group, were confirmed to be normally distribution by the Kolmogorov-Smirnov test (EZR, Rcmdr ver2.1-2), the paired t-test was used for comparison between 2 groups (JMP ver12, SAS). In the case of no normal distribution, Mann-Whitney U test was used. Significant level was less than 5 %. Furthermore, Peason’s correlation coefficient was used to investigate the correlation between RT of PVT and the subjective evaluation by VAS. This study was conducted with the approval of the Ethical Committee, Department of Nursing, Ehime University.

Result

Reaction time in PVT

The mean RT for 10 minutes was 264.6 ± 36.5 msec in the control group and 247.9 ± 32.8 msec in the peppermint group, which was significantly lower in peppermint. Slowest 10 % of reaction time and fastest 10 % of reaction time were also shorter in the peppermint group than in the control (Figure. 3). The mean number of lapse exceeding 500 msec in the RT was 2.3 ± 4.6 in the control and 1.1 ± 2.2 in the peppermint, which was less in the peppermint, but not significant.

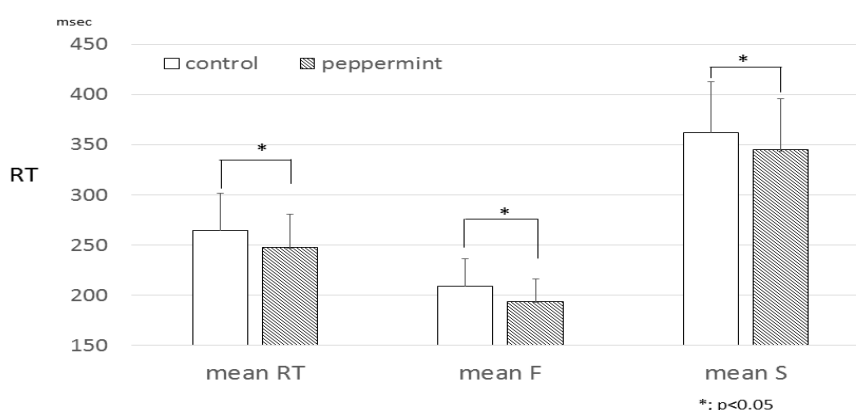


Figure 3: Reaction time (RT) in 2 groups.
 mean RT; average of reaction time.
 mean F; average of the fastest 10 % of reaction time.
 mean S; average of the slowest 10 % of reaction time.

Of the 20 subjects, 9 were controlled and 11 were in peppermint at first trial. The median RT in first PVT in all subjects was 242.9 msec (the lower quartile; 225.5 msec, the upper quartile; 276.7 msec) and 2nd PVT was 250.6

msec (the lower quartile; 231.0 msec, the upper quartile; 288.0 msec), and there was no significant difference between 1st trial and 2nd trial (Figure. 4).

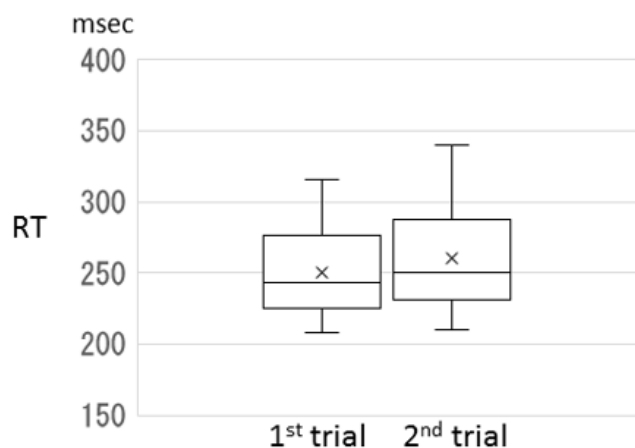


Figure 4: Median RT in measurement order.

Correlation between subjective evaluation and RT

The subjective evaluation by VAS were 42.8 ± 17.1 in the control group and 68.8 ± 18.9 in the peppermint group,

respectively, which was significantly higher in the peppermint (Figure. 5).

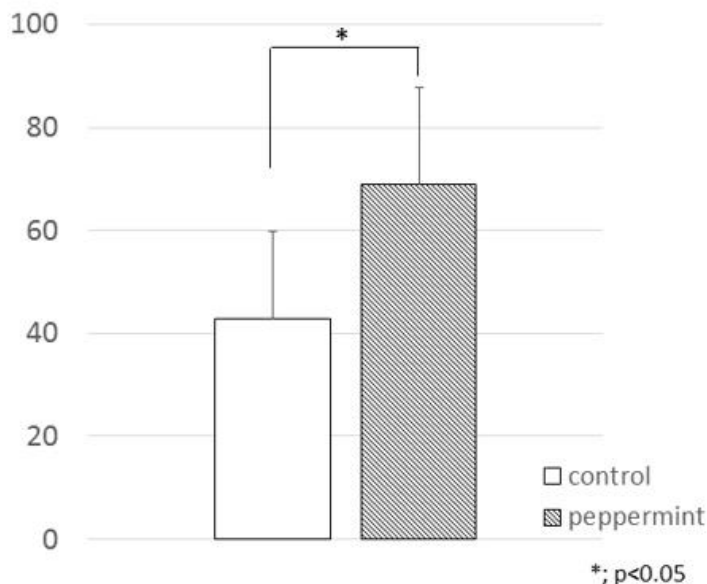


Figure 5: Subjective sustained attention by VAS.

The correlation coefficient between mean RT by PVT and subjective concentration by VAS was $r=-0.3060$, which showed no significant correlation (Figure. 6).

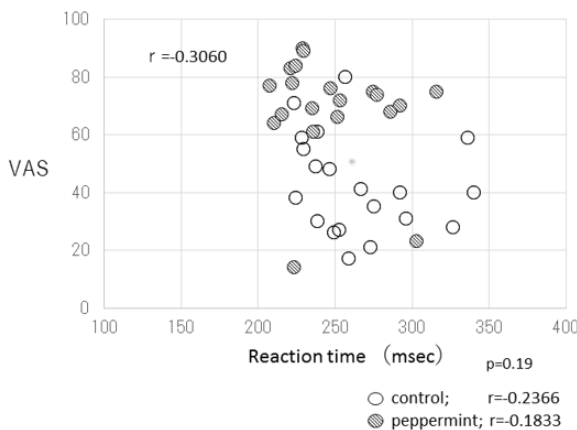


Figure 6: Correlation between mean RT and subjective sustained attention.

Discussion

This study was designed to investigate whether the scent of peppermint improves the sustained attention using PVT. The RT to visual stimuli under the scent of peppermint significantly decreased compared to without scent, indicating that the sustained attention must be increased by the scent of peppermint, which is consistent with the result of previous study [14]. In this case, it is likely that the frequency of early reaction increased, the frequency of late reactions decreased, or both occurred. When the both average RT from the shortest RT to 10% and the average RT from the longest RT to 10% were significantly decreased in the peppermint group compared to the control group.

Therefore, it was suggested that an overall response must be faster under the peppermint.

Furthermore, similar result has been reported by Meamarbashi et al. [15]. In that study, an oral method was used in which 50uL of peppermint oil was placed on the tongue. Although there are different methods in providing peppermint oil between the previous and the present studies, peppermint must reduce the reaction time to sensory stimuli. In other study using infrared video pupillometer, it has been reported that inhalation of peppermint helped eliminate sleepiness by using the degree of pupil instability [7]. Thus, peppermint may be effective in improving sustained attention [16], followed by improving work efficiency. However, Kawamoto et al.

reported that the existence of lemon fragrance had not affect their work efficiency [17]. In their study, Kraepelin test was carried out for 30 minutes as a task and its number of answers and the accuracy rate were evaluated as the index of work efficiency. There were some differences in methods between the previous and the present studies. One is the type of scent, lemon and peppermint, and second is the way of evaluation of work efficiency, Kraepelin test and PVT. PVT used in this study is applied not only for the evaluation of attention and persistence [9, 10] and the degree of sleepiness [11, 12], but also for the attention of jet pilot [18] or nurses [19] who work in shifts. Therefore, although there are no researches about the effect of the scent of essential oil using PVT so far, it seems that PVT must be utilized as a good indicator for evaluating the sustained attention.

Ilmberger et al. reported the influence of scent on human attention evaluated as reaction time and motor time [20]. Reaction time was the periods until pressing the 'go' button to visual stimuli appeared in a monitor, and motor time was the time interval from release of the 'go' button to pressing the other button. Interestingly, their results showed that motor time had improved from 1st to the 2nd trial in the control group with water, indicating motor leaning in the simple motor task. Thus, in performing PVT, there is a possibility that subjects get used to it at the second time and RT would become faster. However, there was no significant difference between 1st and 2nd PVT trials in this study. Therefore, the influence of habituation on PVT could be excluded, and it seems that sustained attention must be increased by smelling the scent of peppermint followed by decreased RT.

In the study using electroencephalogram (EEG) as an indicator, there are differences in the wave types and proportions of EEG or subjective evaluation that appear depending on the concentration of scent [5]. Namely, inhalation of a low-dose lavender scent will cause more alpha waves on the EEG to appear than in middle-and high-dose lavender. Therefore, the concentration of the scent is one of the important factors affecting the results. Since the concentration of scent in the air was not measured in this study, it has been unclear whether the concentration used was appropriate. It seems that the relationship between the concentration of scent and sustained attention is one of the issues that must be examined in the future.

Although the subjective sustained attention by VAS showed higher concentration in peppermint, there was no significant correlation between the objective sustained attention by RT of PVT and VAS, which is consistent with the previous study [21]. In the previous study, although sympathetic nerve activity increased by mental calculation for 10 minutes during lavender inhalation, lavender inhalation induced a positive mood, less stress. These results showed that the subjective concentration or mood the subjects felt during task with scent may not match the actual behavior. Namely, these results suggest that the degree of concentration we feel may not be very consistent with the actual reaction. Therefore, it may be possible to maintain work efficiency by smelling the scent of peppermint when or before feeling tired during work.

It has been known that physiological response is related to the taste of scent. In this study, subjects were not asked whether they liked or not like peppermint scent. So, it is unclear if the scent preference may influence the results in this study. Furthermore, subjects in this study were all female, so the menstrual cycle may have some effect on the result.

Conclusion

This study showed that the presence of peppermint scent increased sustained attention. When or before we feel tired during work, smelling the peppermint scent may improve our concentration followed by lead to prevention of human error.

Acknowledgement

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