THE EFFECT OF ODOR ON CENTRAL NERVOUS SYSTEM WITHOUT OR WITH STRESS

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1-1. GENERAL CONCEPT/BACKGROUND

Through application experienced by physicians and monks before attention was first focused on the numerous essential oils around the 19th century, the selective and function-orientated features of the respective essential oils had been usefully employed. From scientific evidence dating back to the 19th century, some essential oils with special features were defined while many remained non-exploited. Advances in determination methodology and technology of today have unfurled and defined the special features characteristic of many essential oils. Among the many candidates known, essential oils eliciting arousal (excitatory) or tranquilizing (suppressive) effects have been particularly categorized for use. In addition, the norm defining the special features of whether a certain essential oil elicits positive/*yang* (excitatory) or negative/*yin* (suppressive) effects, determines the application of the essential oil in question under particular circumstances has been and is still being practised.

However, there is no such an essential oil that merely elicits either positive/*yang* (excitatory) or negative/*yin* (suppressive) effects. When an essential oil is said to elicit *yin* effects, it means that the essential oil elicits features that incline more to those characteristic of *yin* or suppression (Robert Tisserand, 1985). Thus, in cases where use of an essential oil is anticipated, post-treatment psychological effects (especially via inhalation) can not be excluded; constant use of the same aromatic even when changes occurred in the application field/environment is indeed inappropriate.

The present study therefore elucidated the effects experienced by the subject conditioned in either a stress-free tranquil state or a task-induced stressful state while inhaling an essential oil. In short, the central effects induced by the same essential oil bearing identical features in subjects orientated under two extremely different environments were studied.

In addition, special characteristics of odor perception in the central nervous system (CNS) are intricating; first, olfactory stimulus stimulates the olfactory epithelium and projects the olfactory bulb, the olfactory cortex. Second, the impulse is complicatedly relayed to diencephalon and cerebral cortex, which are amygdala, thalamus, hypothalamus and orbitofrontal cortex. Through this pathway, dynamic neuronal activities of cerebral cortexes can be monitored via electroencephalography (EEG) and interpreted. Odor-related dynamic CNS activities were indexed by spontaneous EEG encompassing Alpha1 wave: A1 (8-10 Hz) and Alpha2 wave: A2 (10-13 Hz), while Alpha Attenuation Test was employed as an index of alertness level.

1-2. ALPHA ATTENUATION TEST (AAT)

AAT is an index that quantitatively defines the alertness level, which is measured by monitoring repetitive movement of opening and closing the eyes of subject in a normal quiet resting state. This determination approach is based on the principle that a difference exists between the arousal level of CNS, represented by the Alpha wave elicited, during the resting and arousal states. The AAT score determines the alertness level; a high AAT value would represent a highly awake state being elicited and subject feels refreshed. However, when an AAT score is low, it could implicate either a low alertness level with the subject behaving inattentive and absent-minded or an extremely high alertness level where the subject become anxious in a strained state (Fig. 1). Details can be retrieved from findings published by Michimori et al. in 1990.

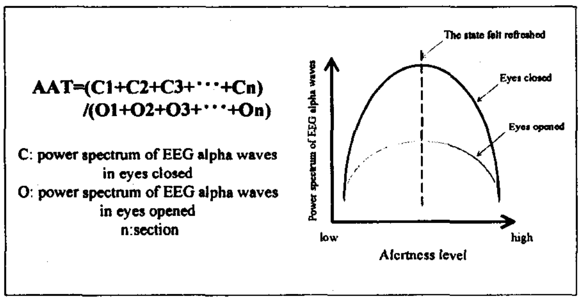


Fig. 1

2. Methods

The present experiment was in climatic chamber No.1 of the Biotron Research Center of Kyushu Institute Design. The present experimental environment was conditioned at an ambient temperature of 28℃ with 50% relative humidity. Eight healthy male university students (aged from 21 to 24years, mean=22.8years) devoid of nasal problems served as subject in the study. Subjects were asked to inhale 5 different odors (diluted with propylene glycol), which are rosemary: RM (concentration 1.0%), lavender: LV (0.5%), *senkyu*: SK (1.0%), eucalyptus: EC (0.5%), bitter orange: BO (0.5%), at random. The present study employed the same aroma and referred to previous findings on the effects of aroma on autonomic activity in our laboratory by Yokoyama et al. (1996), where LV, RM and SK were candidates that elicited suppressive effects, while EC was assessed to elicit an excitatory effect. In addition, BO furnished an impressive olfactory sensation in the subjects, and was then employed as well. Besides performing tests with these odors, a control experiment with an odorless environment was designated as a reference experimental.

The experimental regimen was scheduled as shown in Fig. 2. A 10-min interval was allowed for the subjects to accommodate a resting state after entry to the experimental environment. The physiological responses of subjects were monitored after the interval. It is when subject didn't inhale odor (Control) and when he inhaled odor (Experiment1: Ex.1). The subject was then asked to perform a mental task for 10 min before parallel physiological responses were again monitored while sniffing a given odor (Expriment2: Ex.2). A binary choice test was designated as the mental task, where subjects were obliged to answer a total of 600 questions at a rate of 1 question/sec for a period of 10 min. Subjects were conditioned to provide pretest answers correctly at a rate of more than 90%. The period between Ex.1 and task was designed for resting, and a 10-min accommodation interval was incorporated for nullification of the effects of Ex.1. Opening and closing the eyes were repeated for 3 sessions at alternating (mutually interactive) 1-min intervals for control, Ex.1 and Ex.2. AAT values were concurrently scored accordingly. Spontaneous respiration of the subjects was regulated, and the blood pressure and electrocardiogram (ECG) were then continuously recorded solely for reinforcing physiological correction. EEG activities of the cerebral cortexes were the only parameter taken into account in this study.

Inhalation of odors was pursued according to the bubbling method. The odor intensity was

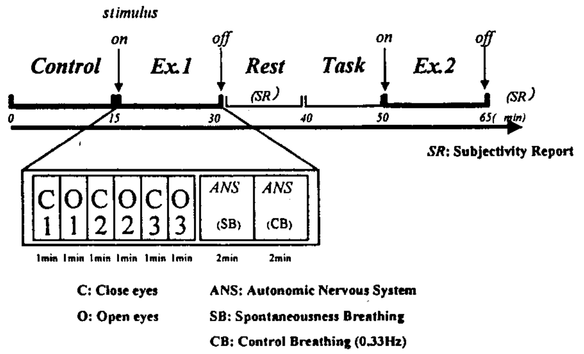


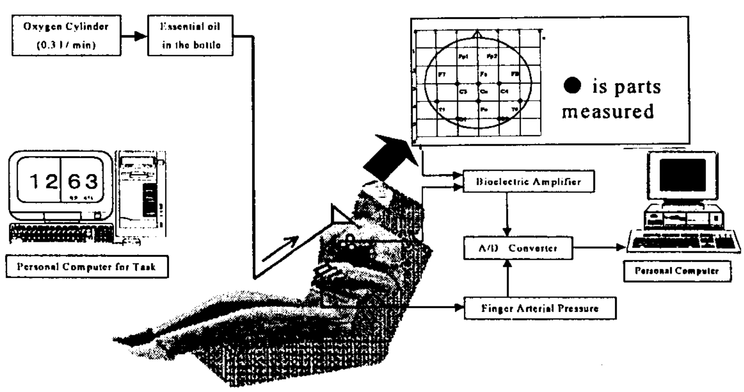
Fig. 2

adjusted, and tubing for delivering the odor was installed and arranged in a fashion that appeared acceptable and would not exert unwanted stress to the subjects. Residual odors were removed from the experimental environment by an exhaust fan (Fig. 3).

3. RESULTS

Means of A1 and A2 values were derived by averaging the differences obtained by subtracting the incidences of A1 and A2 of eye-close section 1,2 and 3 in the AAT paradigm of spontaneous EEG from the respective control values. The 3 major factors of aroma (odor), site and subject were verified by performing the dispersion analysis of 3-dimensional coordination. The results revealed that significant ($p<0.001$) differences in A1 and A2 of major 5 effect of aroma in Ex.1 was established. On comparing differences between any two of the odors at one time with the paired Student*s t-test, LV and RM indicated significantly higher while SK presented lower values with A1 analysis compared with those obtained under an odorless control environment. In the case of A2, BO, EC, RM and SK attained remarkably high values. By using differences obtained in AAT between Ex.1 and control, 3-way ANOVA was performed to evaluate the major effect of the aroma (odor), site and subject. The treated results demonstrated that only the aroma yielded a significant difference ($p<0.001$). Further statistical verification with the Student*s t-test implicated significantly high values were established by EC and RM compared with controls (Fig. 4). In addition, the major effect of aroma with either sensation parameter produced significant differences in Ex.2 when similar statistical verifications were performed. However, EC, LV, RM and SK registered significantly high values compared with odorless control in the case of A1. In a similar tendency, A2 projected significantly high values for LV and SK, accordingly. Also, AAT projected significantly high values for BO, LV, RM and SK, accordingly (Fig. 5).

The above findings summarize that inhalation of EC, RM and SK provoked a higher arousal level whereas LV induced a lower level in Ex.1. As high values registered for A1 and AAT, RM elevated arousal level approximated that of an extremely awake state. Although EC and SK attenuated A1 and enhanced A2,



An outline of Experimental environment and measurement

Fig. 3

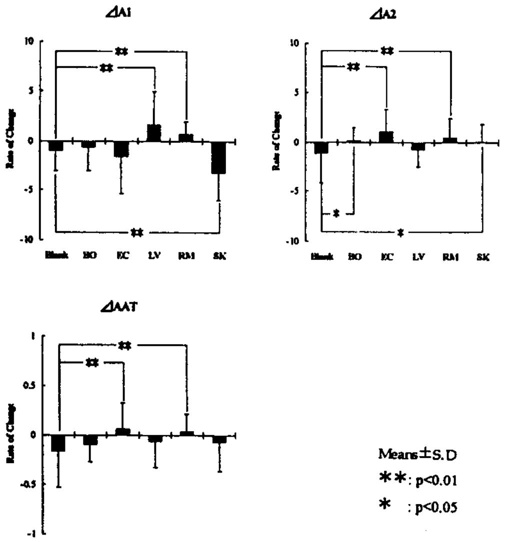


Fig. 4 Ex.1

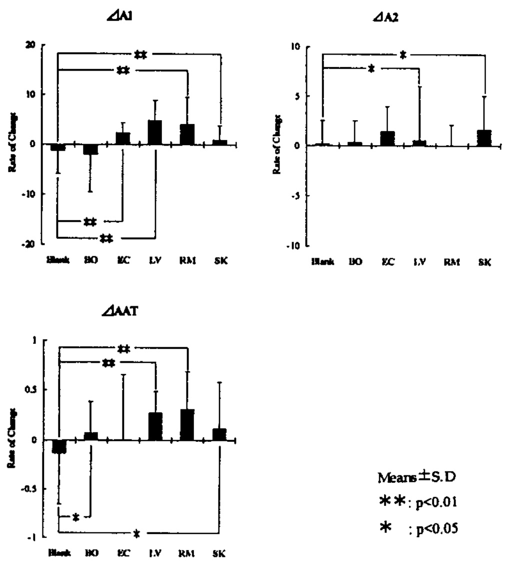


Fig. 5 Ex.2

the arousal level was probably excessively expressed, especially for SK where the AAT value was lowered. These odors are candidates that definitely are not the preferable choices for inducing a good arousal level in a resting environment. Furthermore, BO, LV, RM SK attenuated arousal levels in subjects that were engaged in mental tasks when results in Ex 2 were interpreted. With reference to EC, the vast standard deviation of AAT produced inconsistent results; arousal levels in some were decreased while others did not indicate any changes.

4. DISCUSSION

In elucidation of effects of odors on the CNS activities, two environmental conditions, a stress-free resting and a stress-induced state, were designed in our study a purposeful investigation to explore the special features of positive (yang) and negative (yin) physiological aspects of odors, marked differences in outcome were derived from subjects conditioned under these two experimental environments. LV attenuated spontaneous EEG activities in subjects under both environmental conditions, suppressing the arousal level to eventually induce a tranquilizing outcome. As for the other essential oils employed in the study, the arousal levels were enhanced in a resting state whereas those in a stressful environment were depressed displaying a tendency to elicit yin-yang interchangeable characteristics according to the environment subjected to. Much interest is focused on RM because despite the excitatory (yang) effects it normally exerts on humans, it often facilitates memory retention/performance and promotes a refreshing feeling as well. . Even, in a refreshing feeling induced in the two environmental conditions that arousal is a contrasting feature designated in this study, implications of suppressive (tranquilizing) or arousal facilitating of RM much depended on the time of induction and the situation of subject imposed there and then. All in all, subject to environmental conditions, RM elicited either yin or yang and maybe both effects on humans. Elicitation of whether a yang or a yin effect on humans by an odor is determined by its intensity and concentration as well (Van Toller and Dodd, 1986), and this phenomenon may not account for the effects did not exert any odor in this study. Our findings confirmed that yin and yang characteristics were intrinsic of essential oils, and domination of either elementary effect was subjected and facilitated by the environmental state that probably prevailed through a feedback system that centrally regulated certain sites/centers to promote the predominant outcome while concomitantly depressing the contrasting component.