

## Research on Preference for Fragrances

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We conducted a survey of fragrance preferences that involved 430 subjects. These subjects smelled the fragrances of lavender, lemon, orange, bergamot, Japanese cypress and marjoram. The preferences for the fragrances of lemon and orange were high. It was shown that some fragrances have a consistent trend concerning preference while others do not, and that some fragrances can be divided into responses of positive mood and negative mood.

It was demonstrated that there is a strong correlation between preferable fragrances and positive moods and relaxation caused by smelling particular fragrances. Favorable fragrances tend to induce positive moods and bring about relaxation. Furthermore, same series of fragrances have different actions, and there is a difference in associated preferences and the mood stimulated by their scent according to whether the subjects know the fragrance or what kind of emotions or impressions are provoked by the fragrance.

**key words:** fragrance, preference, mood

### Introduction

It is said that scent is more closely related to our feelings than our knowledge or thoughts, and this concept has been examined regarding various aspects in the fields of psychology and neurophysiology.

In order to investigate the human olfactory system, research has been conducted regarding olfactory threshold detection (Shimizu et al., 1998) and measuring methods (Shimizu & Sugimoto, 1998; Tonoike, 2001; Koga, 2001), etc.

Recently, research involving various activity all cases has been performed to determine how scents affect humans both physically and mentally. For example, studies have measured awakening and sedative effects (Okazaki, 2001), stress-relieving effects (Han & Uchiyama, 2002; Tanizawa et al., 2000), sleeping effects (Saeki, 2002), and changes in working efficiency (Nakano et al., 1997; Kawamoto et al., 2005). In addi-

tions, research has been performed regarding gender differences in comfort levels caused by fragrances (Yoshida et al., 2003), comfortable and uncomfortable moods resulting from scents, and a scent's effect on the environment (Tanizawa et al., 2000; Saeki, 2002).

Furthermore, the impact analysis method includes not only psychological indices such as the profile of mood states (POMS) (Kawamoto et al., 2005), but it has been extended to the measurement indices of central nervous system activities (brain waves) (Kondou et al., 2004; Duan, 2006), automatic nervous system activities (heart beat, R-R interval, low frequency on heart rate variability (LF), high frequency on heart rate variability (HF), etc.) (Shimizu et al., 1998; Tomonobe et al., 2000; Kawamoto et al., 2005), the endocrine system (cortisol, etc.) (Shimizu et al., 2000), and the immune system (s-IgA, etc.) (Han & Uchiyama, 2004). In this way, the functions of fragrances are

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wide-ranging and the effects have been continuously researched.

Recently, aromatherapy using fragrances has received much attention regarding its usefulness in the field of medicine. Aromatherapy primarily uses fragrances of essential oils extracted from plants to affect and change conditions of the body, psyche, and mood (Kusmirek, 1996).

When aromatherapy is conducted: (1) the pharmacological actions of essential oils (action and toxicity, etc.), (2) variables concerning individuality (attributes, preferences, physical and mental conditions, etc.), (3) environmental conditions, (4) presenting conditions (method, density, etc.) and others (expense, etc.) should be considered. Among these variables, the appropriate selection of a fragrance is the most difficult to determine. Although an essential oil with the most appropriate pharmacological affect should be selected by observing a patient's symptoms and condition, it is said that the patient's preference toward a fragrance should also be considered (Ayabe, 2001; Ono et al., 2002). This is supported by many reports showing that the efficacy of a fragrance becomes stronger if the patient actually prefers the scent (Ono et al., 2002; Yagyu & Saito, 1993; Tomonobe, 2000; Wada et al., 2003; Kikuchi et al., 1993; Yoshida & Saeki, 2000). However, it is not easy to select a fragrance from among the thousands available which satisfies these various conditions, while also taking into

consideration the patient's preference.

Because preferences regarding fragrances and the moods stimulated by them are different based on regional, climatic, societal, and cultural variables (Yoshida, 1994), we considered that it may be useful to elucidate how to select a fragrance by surveying which of them Japanese people living in Japan prefer. To date, there have only been a few surveys conducted on the preferences of Japanese people toward fragrances.

Consequently, in order to develop a guideline for the selection of fragrances for aromatherapy, we performed a survey by diluting natural fragrances in order to reveal the relationships between fragrances, preferences for them, and moods they create, as well as the relationship between the preferences toward fragrances and relaxation effects.

## Research Method

### 1. Subjects

Subjects were recruited from university students and participants attending various workshops.

### 2. Research Method

We had subjects smell the fragrances from strips of smelling paper (2×4 cm), the tips of which were doused with a fragrance. We then investigated the kinds of fragrance in association with the moods they stimulated, the degree of preference, and level of relaxation.

**Table 1** Classification of Mood States

Mood state	Mood scale			
	Scales	Scale items		
Positive mood	Active pleasure	Cozy	Buoyant	Refreshing
	Inactive pleasure	Leisurely	Unstrained	Undisturbed
	Familiarity	Nice	Favorite	Enraptured
Neutral mood	Concentration	Prudent	Serious	Tense
	Consternation	Surprised	Upset	Tingling
Negative mood	Depression and anxiety	Anxious	Melancholy	Depressed
	Malaise	Boring	Exhausted	Indifferent
	Animosity	Angry	Offended	Irritated

Tabulated from the scales and scale items of multiple mood scale (Terasaki *et al.*, 1992)

The distance from the smelling paper to the tip of the nose was determined as 10–15 cm as a rough guide, presuming that this was a sufficient distance for subjects to smell each fragrance. The time allotted for smelling each scent was not set, being left to the subject's discretion. The subjects were also told to stop smelling if they felt sick during the survey.

Fragrances were given to subjects in a random order. Subjects selected the fragrance that they smelled from the six fragrances presented, and specified the moods they stimulated from the scale items of the multiple mood scale (Terasaki et al., 1992) in Table 1 (multiple answers allowed). Preference was determined as being either "like," "neutral," or "dislike," and the degree of relaxation was categorized as being "relaxed," "neutral," or "uncomfortable."

### 3. Essential Oils and Density

The fragrances used in this survey were lavender, lemon, orange, bergamot, Japanese cypress, and marjoram. The concentration of fragrances was 0.04%, as used in aromatherapy. The concentration of pure essential oil (Timeridian, Inc., USA) was adjusted with purified water.

Although fragrances can be broadly classified into chemical compounds (concoction) and natural products, a detailed method of scientific classification method has not been established. Therefore, we selected fragrances based on the following criteria:

- 1) Familiar and accessible fragrances: We selected the fragrances of essential oils extracted from natural sources.
- 2) Less toxic and less irritating fragrances.

- 3) Fragrances taking the subjects' burden due to the research into consideration.
- 4) In order to avoid biasing the selection regarding fragrance groups, we selected fragrances from the citrus, flora, tree, and herb groups from the classification system specified by Sasaki (2002).

Six fragrances were selected based on these criteria. These fragrances were classified into those having a sedative action and an awakening action based on the report by Lawless (1996) (Table 2).

### 4. Analytical Method

Statistics were calculated regarding each item for analysis. A  $\chi^2$  test or binomial test was used for the assessment of differences in preferences and moods by the fragrance group, age, gender, and by the sedative and awakening actions. The subjects selected the kinds of fragrances they preferred after smelling them, and the relationships among the correct choice rates for fragrance, preference, and relaxation were assessed using Pearson's correlation coefficient.

For the mood state, the number of answers by fragrance were tabulated and summated with respect to the multiple mood scale variance ("active pleasure," "inactive pleasure," "familiarity," "concentration," "consternation," "depression and anxiety," "malaise," and "animosity"), and calculated as a percentage.

Furthermore, they were classified into positive, neutral and negative moods. The positive mood is the sum of "active pleasure," "inactive pleasure," and "familiarity," the neutral mood is the sum of "concentration" and "fright," and the negative mood is

Table 2 Fragrance Used

	Sedative action	Awakening action
Citrus group	Bergamot	Lemon Orange
Floral group	Lavender	
Herb group	Marjoram	
Tree group	Japanese cypress	

**Table 3** Correct Choice Rate When the Subjects Smelled the Fragrance

Fragrance	Total subjects (430)	Gender		Age group (uncertain, 3)					
		Male (48)	Female (382)	18-19 (71)	20-29 (144)	30-39 (105)	40-49 (82)	50-59 (20)	60-63 (5)
Lemon	90.4	87.5	87.7	87.3	89.6	87.6	87.7	90.0	60.0
Orange	84.8	81.3	81.2	66.2	87.5	86.7	81.5	70.0	100.0
Japanese cypress	74.9	68.8	71.7	81.7	71.5	68.6	70.4	70.0	60.0
Bergamot	41.7	29.2	37.7	31.0	45.8	41.9	27.2	20.0	0.0
Lavender	35.9	25.0	35.1	35.2	31.9	44.8	27.2	25.0	20.0
Marjoram	24.3	18.8	22.5	40.8	17.4	26.7	12.3	10.0	0.0

Unit: %

the sum of "depression and anxiety," malaise," and "animosity." The proportion of each of these making up the overall mood was obtained.

SPSS for Windows 11.5J was used for statistical analysis. Significance was defined as  $P < 0.05$  and  $P < 0.01$ .

## 5. Ethical Considerations

We explained the purpose and methods of the research orally and in writing to the subjects, and emphasized that their participation was of their own free will after we obtained approval from the ethics committee of the University of Occupational and Environmental Health. We also confirmed beforehand whether the subjects had any allergic reactions using a small amount of each fragrance. We instructed the subjects to stop smelling if they felt sick during the survey of fragrances.

## Results

### 1. Subjects

A total of 430 subjects, ranging in age from 18 to 63 years old, participated in this survey. The breakdown by age was as follows: 71 in their teens from 18 to 19 years old (16.5%), 144 in their 20s from 20 to 29 years old (33.5%), 105 in their 30s from 30 to 39 years old (24.4%), 82 in their 40s from 40 to 49 years old (19.1%), 20 in their 50s from 50 to 59 years old (4.7%), and 5 in their 60s from 60 to 63 years old (1.2%), with the ages of 3 participants not being specified (0.7%). There were 48 males (11.2%) and 382 females (88.8%). There was some bias in the

age and gender of the subjects, because universities with many female students were selected and the workshops were randomly selected for recruiting the subjects.

### 2. Correct Choice Rate

Table 3 shows the correct choice rate when the subjects smelled the fragrances and selected the kinds they thought they were (hereafter referred to as the correct choice rate). The correct choice rate for lemon was the highest, at 90.4%, followed, in order, by orange at 84.8%, Japanese cypress at 74.9%, bergamot at 41.7%, lavender at 35.9%, and marjoram at 24.3%. The results of a  $\chi^2$  test regarding the correct choice rates by gender and age showed no significant differences.

### 3. Preferences toward Fragrances

The results of preferences toward fragrances are shown in Table 4. The answer of "like" was highest for lemon, at 67.7%, followed in order by orange at 59.7%, Japanese cypress at 25.7%, lavender at 20.0%, bergamot at 15.2%, and marjoram at 8.2%. The results of a  $\chi^2$  test showed significant differences ( $\chi^2 = 779.982$ ,  $\phi = 10$ ,  $P < 0.001$ ).

There were many answers of "like" for lemon and orange, and many of "dislike" for marjoram. The answers for Japanese cypress, lavender, and bergamot were divided into "like" and "dislike." The results of the  $\chi^2$  test of preferences toward fragrances by gender and age showed no significant difference.



**Table 4** Preference of and Mood State by Fragrance

Fragrance		Preference			Mood state							
		Like	Neutral	Dislike	Positive mood			Neutral mood		Negative mood		
					Active pleasure	Inactive pleasure	Familiarity	Concentration	Consternation	Depression & anxiety	Animosity	Malaise
Lemon	(Citrus group)	67.7	27.9	4.4	65.2	90.7 7.4	18.1	0.2	1.4 1.2	0.7	2.6 3.6	3.6
Orange	(Citrus group)	59.7	36.2	4.2	54.2	90.1 14.0	21.8	0.9	1.8 0.6	0.4	8.4 1.9	6.0
Japanese cypress	(Tree group)	25.7	37.0	37.3	9.2	40.3 26.3	4.8	9.0	15.3 6.3	6.8	44.4 28.2	9.4
Lavender	(Floral group)	20.0	37.0	43.1	12.8	37.8 18.3	6.8	1.8	9.6 7.8	4.8	52.6 35.3	12.5
Bergamot	(Citrus group)	15.2	44.9	40.0	15.1	39.0 17.2	6.7	3.0	10.5 7.5	4.0	50.5 27.4	19.1
Marjoram	(Herb group)	8.8	24.8	66.4	5.9	14.7 8.0	0.8	2.9	18.9 16.0	5.9	66.4 53.4	7.1

Unit: %

**Table 5** Characteristics of Fragrances by Preference

Group	Choice rate of fragrances	Preference			Mood state		
		Like	Neutral	Dislike	Positive	Neutral	Negative
Group I	87.6 ]*	63.7 ]*	32.0	4.3 ]*	89.7 ]*	2.2 ]*	8.1 ]*
Group II	24.3 ]*	8.8 ]*	24.8	66.4 ]*	13.4 ]*	25.9 ]*	60.7 ]*

$P < 0.05$ , Unit: %

Group I: Highly preferred fragrances (lemon and orange)

Group II: Less preferred fragrance (Marjoram)

#### 4. Moods Stimulated by Fragrances

Table 4 shows the results of mood conditions classified into positive ("active pleasure," "inactive pleasure," and "familiarity"), neutral ("concentration" and "fright"), and negative ("depression and anxiety," "malaise," and "animosity") moods.

The fragrance of lemon induced positive moods in 90.7% of the subjects, and that of orange in 90.1%. These results show that the two fragrances of lemon and orange induced consistently positive moods. Conversely, the marjoram induced a negative mood in a high percentage, as much as 66.4%, of the subjects. The fragrances of Japanese cypress, bergamot, and lavender induced positive moods in about 40% of the subjects and negative moods in about 50%. In this manner, the moods induced by smelling fragrances were split into positive and negative ones. In other words, the fragrances of lemon and orange induced a positive mood, that of marjoram induced a negative mood, and the mood induced by Japanese cypress, lavender, and bergamot was split into either positive or negative.

Ascribing mood to the multiple mood scale, more than 50% of the subjects felt a mood of active pleasure generated by the fragrances of lemon and orange. Japanese cypress induced moods of animosity (28.2%) and inactive pleasure (26.3%), bergamot caused various moods such as animosity (27.4%), boredom (19.1%), inactive pleasure (17.2%), and active pleasure (15.1%), and lavender generated various moods such as animosity (35.3%), malaise (12.5%), active pleasure (12.8%), and inactive pleasure

(18.3%). Marjoram led to a feeling of animosity in more than 50% of the subjects. As can be seen from the above, some fragrances stimulated various moods while others were more consistent in the mood they generated in more than 50% of the subjects.

#### 5. Characteristics of Fragrances by Preference

The fragrances of lemon and orange, for which more than 60% of the subjects answered "like," were classified into Group I with a strong preference, and the fragrance of marjoram, for which more than 60% of them answered "dislike," was classified into Group II with a low preference. The characteristics of these groups were then investigated.

Table 5 shows the correct choice rate of fragrances and moods stimulated by them with respect to each preference group. Pearson's correlation coefficient between the correct choice rate for and preferences toward fragrances was 0.414 ( $P < 0.01$ ). The correct choice rate for fragrances was 87.6% in Group I, which was significantly higher than 24.3% in Group II ( $P < 0.05$ ). Furthermore, a binomial test of the correct choice rate for and preference toward fragrances was performed using lemon and orange of Group I and marjoram of Group II. As a result, a significant difference was observed in every item ( $P < 0.001$ ). There were more answers of "like" for the fragrances of lemon and orange and the correct choice rate was also high. In contrast, there were more answers of "dislike" for the fragrance of marjoram and the correct choice rate was coincident

**Table 6** Degree of Relaxation Induced by Fragrances

Kinds of fragrance	Degree of relaxation		
	Relaxed	Neutral	Uncomfortable
Lemon	66.2	29.3	4.5
Orange	63.3	32.4	4.3
Japanese cypress	28.8	37.0	34.2
Lavender	25.9	33.2	40.8
Bergamot	16.8	49.5	33.7
Marjoram	10.7	25.1	64.2

Unit: %

tally low. Thus, a correlation was identified between a favorite fragrance being a known one and an unappealing fragrance being an unknown one.

For the moods stimulated by fragrances, the rate of a positive mood was significantly high at 89.7% ( $P < 0.05$ ), and that of a negative mood was significantly low at 8.1% ( $P < 0.001$ ) in Group I.

## 6. Degree of Relaxation Induced by Fragrances

Table 6 shows the degree of relaxation induced by fragrances. The answer of "relaxed" was highest for lemon, at 66.2%, followed in order by orange at 63.3%, Japanese cypress at 28.8%, lavender at 25.9%, bergamot at 16.8%, and marjoram at 10.7%.

Rates of answers of "relaxed" for lemon and orange were high, at more than 60%, and those of "uncomfortable" for marjoram were more than 60%. Answers for Japanese cypress, lavender, and bergamot were divided into "relaxed" and "uncomfortable."

Pearson's correlation coefficient between the preferences for and the degrees of relaxation induced by fragrances showed a

strong positive correlation at 0.893 ( $P < 0.01$ ).

## 7. Characteristic of Fragrances Classified

The fragrances of the tree (Japanese cypress), followed by citrus (bergamot), floral (lavender), and herb (marjoram) groups among those with a sedative action were compared. The correct choice rates for fragrances are shown in Table 3, and the preferences toward fragrances and the moods they stimulated in Table 4.

The correct choice rate in sequential order was highest with the tree group (Japanese cypress), followed by the citrus (bergamot), floral (lavender), and herb (marjoram) groups, and the result of the  $\chi^2$  test showed significant differences ( $\chi^2 = 299.743$ ,  $\phi = 3$ ,  $P < 0.001$ ).

As a result of the  $\chi^2$  test regarding preference for fragrances, the preferences for these four fragrances differed significantly ( $\chi^2 = 107.194$ ,  $\phi = 3$ ,  $P < 0.001$ ). On residual analysis, the preference for the tree group (Japanese cypress) was high and that for the herb group (marjoram) was low. As a result of the  $\chi^2$  test on the moods stimulated by smelling fragrances, the moods induced by the four kinds of fragrances differed significantly ( $\chi^2 = 103.747$ ,  $\phi = 6$ ,  $P < 0.001$ ). On residual analysis, the tree group (Japanese cypress) stimulated positive moods and the herb group (marjoram) stimulated negative ones.

## 8. Characteristic by the Difference of Action of the Citrus Group

Although they belong to the same citrus group, bergamot has a sedative action and lemon and orange have an awakening action. Table 7 shows a comparison between

**Table 7** Characteristics of Fragrances of the Citrus Group

Fragrance action	Choice rate of fragrances	Preference			Stimulated mood		
		Like	Neutral	Dislike	Positive	Neutral	Negative
Sedative action	41.7	15.2	44.9	40.0	37.0	14.9	48.0
Awakening action	87.6	63.7	32.0	4.3	89.7	2.2	8.1

Note: Bergamot for sedative action and lemon and orange for awakening  $P < 0.05$ . Unit: % action

them.

For the fragrances that had an awakening action, 63.7% of subjects answered that they "liked" the fragrance, which was significantly higher than those scents with a sedative action ( $P < 0.05$ ). Further, 89.7% of the subjects expressed that a "positive mood" was stimulated by the fragrances with an awakening action, which was significantly higher than those scents with a sedative action ( $P < 0.05$ ). The correct choice rate for fragrances with an awakening action was significantly higher, at 87.6%, than those with a sedative action ( $P < 0.05$ ).

It was shown that there were differences in preference toward and mood stimulated by the fragrances of the same citrus group, which is likely if the subjects knew the actions and fragrances.

### Consideration

#### 1. Preferences for Fragrances and Their Characteristics

##### 1) Fragrances and Preferences

In this study, subjects smelled six kinds of fragrances, and preferences were high for the citrus group of lemon and orange. These results correlate with the those of Kawai (2001). The preference for the fragrance of marjoram was low. However, preferences for the fragrances of Japanese cypress, lavender, and bergamot were split, indicating that some fragrances have variable preferences based on the individual.

It is said that individual preferences toward certain fragrances greatly affect the results of aromatherapy. For example, Kawabata (2000) reported that people relax if they like a fragrance resulting in favorable effects on the hypothalamic area. In contrast, in people who dislike the same fragrance, the sympathetic nervous system is activated and blood flow in the hypothalamic area decreases, resulting in adverse effects. Moreover, Kikuchi (1993) reported that the efficacy of a fragrance improves if the preference for it is high. In this way, the effect of a fragrance varies greatly according to preference, making it important to

consider the patient's preference when aromatherapy is performed.

##### 2) Moods Induced by Fragrances

Many subjects expressed positive moods when they smelled the fragrances of lemon and orange, and negative moods associated with the fragrance of marjoram. However, the fragrances of Japanese cypress, bergamot, and lavender induced either positive or negative moods. It has been previously shown that a pleasant scent induces a positive mood (Lawless, 1996).

##### 3) Preference Toward and Correct Choice Rate for Fragrance

This study showed that fragrances that can be correctly and readily recognized (known fragrances) are preferred and induce positive moods. Generally, for a fragrance that is easily recognized, the resulting feelings are likely influenced by the generic properties of the conceptualized material (Ayabe, 2001). The result of this research revealed the same trend. In other words, lemon and orange are well-known and they have the characteristics of being refreshing, sweet, and sour, so that they were considered to induce positive moods. It is presumed that because lemon and orange are familiar, these fragrances tended to induce positive feelings. In contrast, the fragrance of marjoram is not well-known, making it difficult to induce familiar feelings, and, consequently positive moods.

##### 4) Preference and Relaxation Induced by Fragrance

There was a strong correlation between the preference toward, the relaxation afforded by, and the positive moods induced by a fragrance. It was shown that fragrances that were predominantly preferred induced positive moods and brought about relaxation.

#### 2. The Characteristics of Fragrances by Systematic Classification

The preferences toward and moods stimulated by the bergamot fragrance of the citrus group, Japanese cypress of the tree group, lavender of the floral group, and mar-

joram of the herb group were investigated.

It was shown that the preference toward the tree group (Japanese cypress) was high, and that toward the herb group (marjoram) was low. However, Kawai (2001) reported that preference toward the citrus group is the highest, followed in order by the floral and tree groups. This difference may have occurred because of the familiarity of the fragrances. In this research, the choice of, preference toward, and moods stimulated by the fragrances of lemon, orange, and marjoram of the citrus group were investigated. The familiar fragrances of lemon and orange, both having a favorable image, were preferred and induced positive moods more often than the less familiar fragrance of bergamot. In this way, because a familiar fragrance with a favorable image is often preferred, it is presumed that when comparing fragrances by group, if familiar fragrances such as lemon and orange are used, the results will be different.

In this manner, there are differences in the preferences toward and moods induced by the fragrances according to whether they are familiar ones, even if they are of the same group.

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### References

- Ayabe, S. 2001 Effect of language labels on uncomfortable feeling of scent. *Aroma Research No. 6*, 2(2), 39–34.
- Duan, X., Tashiro, M., Wu, D., Yambe, T., Nitta, S., & Itoh, M. 2006 Heart rate variability in autonomic function and localization of cerebral activity during inhalation of perfumed fragrances. *Journal of International Society of Life Information Science*, 24(2), 390–395.
- Han, J. & Uchiyama, A. 2002 The effect of aroma on stress loading verified from physiological response. *Human Science*, 14(2), 98–106.
- Han, J. & Uchiyama, A. 2004 The Effect of odor presentation on immune function free stress loading. *Journal of International Society of Life Information Science*, 22(2), 577–576.
- Kawamoto, R., Murase, C., & Ishihara, I. 2005 Effect of the fragrance of lemon on performance and physiological parameters during task performance. *Japanese of University of Occupational and Environmental Health*, 27(4), 305–313.
- Kawabata, K. 2000 *Clinical Aromatherapy*. Medica Shuppan, 23.
- Kawai, T. 2001 Presenting conditions of environmental fragrances and psychological peactions. *Aroma Research No. 6*, 2(2), 58–67.
- Kikuchi, M., Tanida, M., Uenoyama, S., Abe, T., & Yamaguchi, H. 1993 Effects of fragrance on human body—Changes in heart beat at response prediction condition—. No. 27 Taste and Smell Symposium's Collection of Paper, 27–29.
- Koga, Y. 2001 Physiological evaluation of aroma by using EEG and rCBF. *Aroma Research*, 1, 55–60.
- Kondou, T., Yamada, S., Shioda, S., & Torii, K. 2004 Brain activation in response to olfactory stimuli by essential oils. *Journal of Japanese Society of Aromatherapy*, 3(1), 23–28.
- Kusmirek, J. 1996 Perspective of Aroma Therapy (S. Bang Toller, and G. H. Dotto version), Physiology of Fragrance. *Fragrance Journal*, 255–260.
- Lawless, J. 1996 Aroma Therapy to Heal the Mind (Trans. Hayashi, O.), *Fragrance Journal*, 106–119.
- Nakano, Y., Hatayama, T., & Kikuchi, A. 1997 Effects of hedonic tones evoked by odor stimuli on human mental work. *The Japanese of Research on Emotions*, 4(2), 44–54.
- Okazaki Y. 2002 Stimulative and sedative effect of the odor. *J. Odor and Eng.*, 32(2), 21–26.
- Ono, A., Hara, M., Sasaki, N., Tomonaga, A., & Machida, K. 2002 Efficacy of aroma Therapy for the relaxation for the patient dur-

- ing awake surgery. No. 33 Japan Nursery Association's Collection of Paper (Adult Nursery I), 181-183.
- Sasaki, K. 2002 *The First Experience of Aroma Therapy*. Ikeda Shobo, 70-71.
- Saeki, Y. 2002 Evidence from bad smelling environments in sick beds. *Clinical Nursing*, 28(13), 1993-1941.
- Shimizu, J. & Sugimoto, S. 1998 An experimental study of the effect of odors on affection—The analysis of autonomic nervous system—*Bulletin of Aichi Shukutoku University—Faculty of Letters—*, 23, 129-137.
- Shimizu, J., Naga, S., Tamaru, M., & Sugimoto, S. 1998 The effect of affective experiences caused by odors on autonomic nervous system. *Bulletin of the Fujita Medical Society*, 22(2), 19-23.
- Shimizu, J., Sugimoto, S., Naga, S., & Tamaru, M. 2000 The effect of affective experiences caused by odors on HRV and level of the cortisol of saliva, *Journal of Japanese Society for Physiological Psychology and Psychophysiology*, 18(2), 143.
- Tanizawa, S., Kan, C., Goto, M., & Okuda, T. 2000 A study on the influence of aroma and environment in the relief of mental and physical stress. *The Japanese Journal of Stress Science*, 15(1), 96-103.
- Terasaki, M., Kishimoto, Y., & Koga, A. 1992 Construction of a multiple mood scale. *The Japanese Journal of Psychology*, 62(6), 350-356.
- Tomonobe, N., Hagino, I., Watanuki, S., Yokoyama, N., & Funada, Y. 2000 Effect of preference to odors on autonomic nervous system. *Japanese Association for the Study of Taste and Smell*, 7(3), 335-338.
- Tonoike, M. 2001 Objective measurements of fragrance using olfactory neuromagnetic and evoked responses. *Aroma Research*, 1, 31-37.
- Wada, M., Usui, N., Sato, A., & Nagai, M. 2003 Psychosomatic effects of pleasant odors. *Aroma Research No. 14*, 4(2), 26-30.
- Yagyu, T. & Saito, M. 1993 Neurophysiology of essential oil—Inhibitory effect of lavender. *Aromatopia*, 2, 54-57.
- Yoshida, S. & Saeki, Y. 2000 Effect of fragrances on autonomic nervous system. *Journal of Japan Society of Nursing Research*, 23(4), 11-17.
- Yoshida, T. Kubota, M., & Komaki, R. 2003 A sex difference of a comfortable degree domain for fragrance. *Aroma Research No. 13*, 4(1), 40-45.
- Yoshida, T. 1994 An action of fragrance on the brain and relaxation. *Aromatopia*, 6, 34-37.

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