

## The Effects Caused by Lavender and Rosemary for Salivary Cortisol, Stress Levels and Mood Alteration

Lee Aeran · Cho Hongbum<sup>†</sup>

Dept. of Beauty Art, Seokyeong University

Dept. of Chemical & Biological Engineering, Seokyeong University<sup>†</sup>

### Abstract

This study is being conducted in order to confirm the effects of inhaling method for aromatherapy on cortisol which is a stress hormone by the saliva test method. An attempt is being made to determine if there are any differences between the effect of lavender and rosemary when considering their effects on the cortisol level. The test shows a statistically significant decrease in the cortisol level (Table 4), and as far as the comparison of the effects between lavender (N=10) and rosemary (N=10) is concerned, the lavender group shows a p-value of .005 which means that there are no statistical significances; while the rosemary group shows p-values of .081 meaning that there is a decrease in cortisol levels, which is statistically significant (Table 5). It has been proven that the saliva test method is a practical and scientific method when confirming the effects of aromatherapy and also a convenient method for both of the test coordinator and the subjects. Results of all 20 subjects showed similar results obtained by means of conventional blood tests. However, the rosemary group shows statistically significant decrease in cortisol level compared to the lavender group, thus proving that the test method for studying the effect of aromatherapy on stress is valid. Further studies should be conducted in order to investigate the differences in the effects of the cortisol level at different concentrations of the aroma.

**Key words** : cortisol, lavender, rosemary, saliva test, stress hormone

### I .Introduction

Aromatherapy is one of the fastest developing complementary alternative medical fields today.

Aromatic plants have been recognized for thousands of years since the ancient days for their effects on our health both directly and indirectly through intuition or experiences in their

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Corresponding author: Cho Hongbum, Tel.+82-2-940-7614, Fax.+82-2-940-7616  
E-mail: hbcho@skuniv.ac.kr

lives. However, its utilization has been quite limited due to the fact that study on its biochemical mechanism has not been sufficiently conducted. Fortunately, as the scientific analytical technology has been developed recently and more studies on aromatherapy have proved its effect, the therapy has become popular more than ever.

Aromatherapy has been extensively used clinically and lately reported in their study that quality of life of cancer patients was improved by the means of aromatherapy and also on the positive effects on insomnia. It have reported its effect on anxiety conditions experienced by dementia patients, further reporting on the effects on decrease in depression and anxiety conditions.

Also, It has reported in their study on its effect on backache and arthralgia. There were reports on antibacterial function of the aromatherapy (Baum & Grunerg, 1995).

As illustrated above, applications of essential oils have been expanded and aromatherapy has contributed to the promotion of general health and preventive medicine, as well as clinical therapeutic activities (Hur & Han, 2004). Even though

aromatherapy is being used extensively it can be explained that the most fundamental mechanism is neurophysiology mechanism related to relieving of stress (Bolini & Grunerg, 2004).

How aromatherapy affects stress fast is due to the olfactory system, unlike other sensory systems, such as taste, tactile, auditory and visual systems, functions differently. Generally most sensory informations are delivered through the brain stem to thalamus, where the informations are distributed to respective sensory centers in the cerebral cortex. However, in the olfactory system the informations do not go through olfactory bulb which is a part of the limbic system, but directly to the limbic system.

There is an evolutionary significance in such a function of the olfactory system. Prior to the development of civilization, human beings had to rely on the fastest olfactory system that can respond immediately to a variety of stress levels. Olfactory sense can respond fast to human effectivity, which can affect limbic system that neurotransmitter dispersed in itself, such as controls the mood. Limbic system has diverse dopamine, serotonin and norepinephrine. Therefore, aromatherapy can immediately act

**Table 1. Current Trends of Clinical Studies on the Effects of Aromatherapy**

Clinical Applications	Cases of Clinical Studies
Cancer	Studies on Improvement of Quality of Life for Cancer Patients
Dementia	Studies on Anxiety of Dementia Patients
Mood Disorder	Studies on Depression and Anxiety
Sleep Disorder	Studies on Insomnia
Pains	Studies on Backache and Arthralgia
Antibiotic Effects	Studies on Antibacterial Functions
General Health and Preventive Medicine	Studies on the General Health and Preventive Medicine

on neurotransmitter in the limbic system controlling the mood, affecting the automatic nervous system, the immune system and the endocrine system, eventually all parts of the human body. Many scientific researches have been conducted recently in order to prove the clinical effectiveness of the aromatherapy (Cawley, Corner, & Hildebrand, 1995).

Studies on the effectiveness of aromatherapy have been conducted by comparing the measurements of cortisol value in blood or in urine before and after, in vivo and in vitro. However, since these methods are invasive and clinical methods which have many limitations for non-medical professionals to conduct clinical studies on the effects of aromatherapy.

Recently there have been many attempts to find a more convenient method while maintaining reliability of the research in order to overcome these limitations. One of the typical method is Saliva test. Clinical studies by the means of saliva test have been widely conducted overseas (Cha, Kim, Kim, & Kim, 2010). Medical studies by the means of saliva test method have been reported in the fields of medicine domestically, however rare in non-medical fields, such as the field of beauty science (Frankernhause, 1986).

Therefore, in this study we intended to confirm the influence of aroma therapy on the stress hormone and mood changes by means of saliva test method for the first time in the field of beauty arts in Korea, and also to compare it with research data obtained through the existing blood test method in order to confirm its reliability as a test method useful for neurophysiological researches to be conducted by therapists in the fields of beauty arts in the future.

## II. Study Method

### 1. Study Subjects

On April 28, 2013, twenty subjects who were students of Beauty Science Department of S Woman's University in the Seoul Metropolitan Area have been selected further who understood and agreed with the purpose of this experiment. Selection criteria set by the experimenter were healthy women who had no physical or mental health problem, 1) who did not take any medication or drugs, such as invigorating drink, antioxidant, etc. on the experiment date, or 2) who has no ailment in adrenal or kidney, or did not take any steroid, or 3) who was not taking any hormone treatment at that time. Study subjects were randomly divided into two groups by the means of random table: lavender group and rosemary group. Physical characteristics of these subjects were shown in Table 2 below.

### 2. Study Method and Procedures

#### 1) Questionnaire

The test subjects were surveyed on general information (name, sex, age, marital status, height etc.), Stress VAS (Stress Visual Analogue Scale) designed by Cline, stress levels and the measurement of the scale in mood changes.

#### 2) Saliva Collection Method

No food or drink should be consumed 90 minutes prior to the saliva collection, and mouth shall be rinsed with water in order to remove existing saliva, and any medicine that can affect saliva excretion should be prohibited from the day prior to the experiment in order to remove any factors that could affect the saliva excretion or components of the saliva itself.

Table 2. Physical Characteristics of Subject

Variables	Lavender Group (n=10)	Rosemary Group (n=10)	t	p
Age (yr)	35.75±7.30	33.90±9.23	.462	.650
Height (cm)	160.75±4.92	162.90±3.60	-1.071	.300
Weight (kg)	53.38±7.28	56.40±8.78	-.781	.446

Mean±S.D

\*p<.05 : p-value is measured by paired t-test

Experiment subjects rinsed their mouths with water, and 10 minutes later their saliva were collected. Saliva was collected right before inhaling the aroma and the treatment with massage, and after the treatment with the blended aroma essential oil. Collected saliva samples were tested by means of ELISA (Enzyme-linked immunosorbent assay) analyzing method which was used to analyze the clinical specimen at the Neodin Medical Research Institute (Seoul, Korea).



Figure 1. Saliva Collection Kit

## 2) Aroma Essential Oil Handling Method

(Inhaling and Massage)

### (1) Prescription

For the aroma essential oil, lavender (*lavandula angustifolia*) that is effective for insomnia, sedation, relaxation and stress related conditions and rosemary (*rosmarinus officinalis*)

that is effective for migraine and relaxation of nervous system were used. The essential oils were selected by an aroma therapist, internationally recognized by ITEC and IFA, and borage oil was selected for a carrier oil in that each of the two aromas was blended to make up 3% of the borage oil (Hur & Han, 2004).

### (2) Inhaling and Application

One drop(0.04ml) of the blending oil contained in a brown bottle protected from the light was taken and dropped on the palm and rubbed with both hands. While sitting on a chair comfortably, the subject held her palm 10cm away from her nose and inhaled for 10 minutes. After the inhaling, the subject started massaging her neck(rear and both sides) for 10 minutes and then massaged her foot and ankle for 10 minutes.

Ten subject members from the lavender group and another 10 subject members from the rosemary group inhaled the 3% blending oil and massaged themselves according to the method described in Table 3.

Concentration of 3% means blending 3% essential oil(6 drops) with 10ml of carrier oil(borage oil).

## 3. Processing the Materials

Data obtained from this study were processed with SPSSWIN(ver. 15.0), obtaining mean

values(M) and standard deviations(SD) for the changes in cortisol and stress levels in saliva samples before and after inhaling the aroma. Independent t-tests were performed to confirm the differences between groups and periods, while matching samples, t-tests were used for the changes before and after the experiments. And  $\Delta\%[(\text{post-pre})/\text{pre} \times 100]$  were calculated in order to evaluate the rate of change per variable before and after. Level of statistical significance was set for  $p < .05$ .

### III. Study Results

#### 1. Changes in Cortisol Values

Table 4 shows the results of statistical analyses of the changes in cortisol values of the subjects before and after the aromatherapy. In the case of the lavender group the values changed from  $3.94 \pm 1.81$  mg/dl to  $3.08 \pm 0.26$  mg/dl showing a 21.82% decrease which is statistically significant ( $p < .01$ ), while in the case of the rosemary group the values changed from  $4.00 \pm 1.53$  mg/dl to  $2.68 \pm 0.77$  mg/dl showing a 33% decrease which is statistically significant ( $p < .01$ ).

**Table 3. Procedure of Inhalation and Application**

Program Stages	Procedure
Preparation (5 min.)	<ul style="list-style-type: none"> <li>• Remove accessories</li> <li>• Put on a gown</li> <li>• Put on a turban</li> </ul>
Inhalation (10 min.)	<ul style="list-style-type: none"> <li>• 10ml of borage oil+6 drops of lavender(3%)</li> <li>• 1 drop on the palm, rub it, and inhale for 10 min.</li> <li>• Room temperature: 22~26° C</li> <li>• Humidity: 50%~60%</li> </ul>
Self Neck Massage (10 min.)	<ul style="list-style-type: none"> <li>• Back and sides of the neck</li> </ul>
Self Foot Massage (10 min.)	<ul style="list-style-type: none"> <li>• Feet and ankles</li> </ul>
Finishing (10 min.)	<ul style="list-style-type: none"> <li>• Relaxation</li> </ul>

**Table 4. Change of Cortisol**

Variables	Group	Before	After	t-value	p-value	Δ%
cortisol (mg/dl)	Lavender	$3.94 \pm 1.81$	$3.08 \pm 1.26$	4.639**	.001	-21.82%
	Rosemary	$4.00 \pm 1.53$	$2.68 \pm 0.77$	3.545**	.006	-33.00%

Mean±S.D

\* $p < .05$ , \*\* $p < .01$  : p-value is measured by paired t-test

## 2. Changes in Stress Index and Mood Index

Changes in stress indexes before and after the aromatherapy were statistically analyzed as shown in Table 5. For the lavender group, stress index was  $7.38 \pm 2.3112$  before the therapy and  $5.13 \pm 2.58$  after the therapy, showing a decrease of 0.18%, which is statistically significant ( $p < .01$ ), while for the rosemary group stress index was  $5.30 \pm 2.45$  before the therapy and  $4.40 \pm 2.06$ , showing a decrease of 0.07%, which is not significant statistically.

Changes in mood indexes before and after the aromatherapy were statistically analyzed. As for the lavender group, mood index was  $0.904 \pm 0.02$  before the therapy and  $0.892 \pm 0.02$  after the therapy, showing a 1.32% decrease, which is statistically significant ( $p < .01$ ), while for the rosemary group mood index was  $0.903 \pm 0.03$  before the therapy and  $0.895 \pm 0.03$  after the therapy, showing a 0.88% decrease, which is statistically significant ( $p < .05$ ).

## IV. Discussion

In this study, cortisol concentrations in the human body after the aromatherapy were

measured with saliva samples. Evaluation of the stress is a very significant field because the stress can directly affect human health through diverse paths. Evaluation study on stress prior to recent application of saliva test method will be looked into briefly. Studies on stress evaluation up to recent years had shown different perspectives depending upon

whether definition of the stress or influences on human body is focused, and the development of science in this field has made some influences on the perspective as well. In the past, environmental factors related to stress, personal cognitive nature, emotional conditions, etc. constituted the core of the definition of stress that these factors were the primary targets of the stress measurements (Holmes et al., 2002).

Such trend still persists, yet as the scientific methodology develops, focus has shifted from objective to subjective stress measurement method by the means of biological marker, which is the focus of the stress measurement. The biological marker is perceived by stress central nervous system (cerebral cortex), transmitted, through amygdala which is responsible for emotional memory, to hypothalamus where it stimulates pituitary gland, and then it travels through the endocrine system, automatic nervous system and immune

Table 5. Change of Stress Index

Variables	Group	Before	After	t-value	p-value	Δ%
Stress Index	Lavender	7.38±2.32	5.13±2.58	4.025**	.005	-0.18%
	Rosemary	5.30±2.45	4.40±2.06	1.964	.081	-0.07%
	t-value	-1.675	-1.653			
Mood Index	Lavender	0.904±0.02	0.892±0.02	-3.833**	.002	-1.32%
	Rosemary	0.903±0.03	0.895±0.03	2.256*	.041	-0.88%
	t-value	.945	-.795			

Mean±S.D

\* $p < .05$ , \*\* $p < .01$  : p-value is measured by paired t-test

system, then reaching different parts of the body (Helhammer & Kirschbaum, 1989).

Although studies on immune system in relation to stress have been recently active, studies on endocrine system in relation to stress by means of biological marker have been steadily conducted from the past until present. The reason that hormones are measured in stress related studies is that most systems of our body are influenced by stress showing changes in the body systems through hormone markers. The author believes that the reason for measuring the hormone changes is that the sympathetic nervous system along with activated HPA axis (hypothalamus-pituitary-adrenal axis) plays the major role in the stress response (Kathi & Mindy, 2009).

Such changes are fundamental phenomena in physical changes associated with stimuli, and they are markers that make it easier to identify physiological changes during the period of stress than any other biological signals, such as blood pressure, pulsation, finger temperature, skin resistance, sweat in the palm, etc. In addition, measurement of function of the endocrine system during stress is necessary to find out another aspect of stress mechanism in relation with sympathetic nervous system and HPA axis, or the effect on process of disorder caused by stress.

Hormones used as biological markers in relation with stress are catecholamine, cortisol, growth hormone, estrogen, luteneizing hormone and thyroid hormone. Among these hormones, cortisol is known as the hormone most closely related to emotional stress variables, such as anxiety or depression. Thus, cortisol was selected for this study to evaluate the effect of aromatherapy on stress hormone (Keiichi & Toshiko, 2007).

From the past until now, blood or urine test method has been widely used in measuring cortisol for stress related studies. For urine test, sample has to be collected over a period of 24 hours, thus making it very difficult to secure subjects who are willing to participate in the study. And another adverse factor is that stimulation of the sympathetic nervous system is dispersed over a period of time that effect the stressor hence also become dispersed. As for blood tests, the process of venipuncture might be already stressful to the subjects. In order to compensate such disadvantages with urine or blood test, saliva test method for measuring the cortisol level has been recently widely utilized. The advantages of the saliva test are the fact that samples can be easily collected unlike the stress inducing venipuncture, saliva sample makes it possible to study acute stress effect compared to the urine samples, and also makes it possible to evaluate over a period of time, and researchers need not worry about the problems associated with the measurement of blood or urine samples, such as difficulties in securing subjects, possible problems associated with physical confinement of the subjects (Lee, 2011).

Twenty subjects participated in the study were explained to about the saliva test method, and none of them expressed any inconvenience or complaint and cooperated willingly. Cortisol values in saliva before and after the aromatherapy decreased by 21.82% for the lavender group and decreased by 33% for the rosemary group, showing statistically significant results. This can be interpreted that the cortisol level decreased because the stress was alleviated by the aromatherapy within a very short period of time. Similar results have been obtained in other studies (Renoux, Biziere, &

Reoux, 1987).

Such a fast alleviation of the stress is due to the distinct characteristic of the olfactory system. Smell is the only sense where the receptor of the peripheral nerve has a channel directly connected to the brain while is in contact with the outside world. All matters and senses have to go through the blood-brain-barrier(BBB), but the olfactory nerves have no blood cerebrovascular barrier. Since the olfactory nerve has no cerebrovascular barrier, olfactory informations are processed within a second.

In the author's study on the blood cortisol level in connection with aromatherapy, it took a while to detect changes in the cortisol levels in the blood samples, while the saliva test method did not take too long, thus making it a very effective method. Even if aromatherapy is effective in relieving stress fast, the period for the remaining stress relieved may be a very important factor in deciding whether aromatherapy is going to be clinically used or not. This means that the necessity for further studies on the development of methodology for relieving stress and its effective period is imminent.

However, up until now, studies on the comparison of stress alleviating or cortisol decreasing effect between lavender and rosemary has been seldomly made either by means of saliva test method or by any other methods. There is a research in which lavender stimulates parasympathetic nervous system to alleviate stress, thus decreasing the cortisol value (Sanders, Diego, & Fernandez, 2002).

Lavender essential contains a considerable quantity of ester that relaxes the controlling function of the parasympathetic nervous system, thus creating a sedation effect on the nervous

system. On the contrary, rosemary is rich in oxides and monoterpene which stimulate nervous system under the control of the parasympathetic nervous system, enhancing memory and concentration (Serafinim & Rio, 2004).

Moskowitz and Gerbers et al. asserted in their research paper that effect of lavender was prominent in lower concentrations while the rosemary was outstanding in higher concentrations. And it has been reported that generally, too high a concentration makes one feel unpleasant hence stress alleviating effect cannot be achieved. In this study 3% of lavender and 3% of rosemary were used, however studies on which one is more pleasant or unpleasant at the same concentration should be conducted.

Cortisol value can be increased by a stressor, and a treatment that controls the stressor makes the cortisol value decrease. Many studies have been conducted on how negative emotional stresses increase the cortisol levels, however it is hard to find a research paper that a positive stressor, a pleasant stimulus lowers the cortisol level (Sin, 2006).

It was discovered that cortisol value was decreased when a baby Japanese monkey was stimulated with lavender essential oil. Therefore, it is necessary in the future to further study whether different concentrations of lavender or rosemary in stress hormone studies make the subject feel pleasant or unpleasant, if so, by how much. Therefore, one should be cautious when interpreting the results of this study.

And the following points should be taken into account. First, in this study, the number of the subjects was small therefore one or two values could have influenced the overall results out of proportion. Second, whether using the same concentration for lavender and rosemary in the

comparison study was appropriate or not it must be further investigated. Third, all the subjects in this study were females that their preference on aromas might have influenced the cortisol values. Therefore, prior evaluation must be conducted whether there are other aromas that these subject prefer much more than what were used in this study.

In spite of the facts that there were some limitations that the number of the subjects was too small and the subjects were all females, it was possible to confirm that the aromatherapy alleviated stress levels without much inconvenience to the subjects. As a researcher, author found the evaluation method convenient and it was encouraging to have results showing a significant reduction of cortisol values just as those obtained by the means of blood test method, in such a short period of time. This study also proved that the saliva test method can be an alternative method in studying the stress by the means of aroma to the existing test methods in the future.

## V. Conclusion

In this study, effects of aromatherapy on the stress hormone and mood changes were examined by means of saliva test method before and after the therapy. and the results were as follows:

1. All of the researchers and the objects were able to participate in this saliva test study quite comfortably.
2. Both the lavender group and the rosemary group showed statistically meaningful differences in cortisol levels before and after the aromatherapy.

3. Both the lavender group and the rosemary group showed statistically meaningful decreases in the mood index changes before and after the aromatherapy.

4. In the sense of aroma between lavender and rosemary, it was studied that lavender had a more attentive result hence considering rosemary to have given out a strong Oxide scent.

5. Results of the study showed that this non-medical saliva test method is easy to employ, and the reliability of the test itself manifested that the method will provide ample motivations and means for the therapists in the beauty arts field in conducting the neurophysiological researches in the future.

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