

Effectiveness of Indonesian Essential Oil Mixture of Lemongrass, Cananga, and Patchouli in Relaxation through Inhalation: A Clinical Test on Healthy Woman with High Potential for Stress

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Abstract

Relaxation is one of many mechanisms for coping with stress. One of the most widely used methods for relaxation is aromatherapy with the application of essential oils. Known for their therapeutic benefits, essential oils can be extracted from various Indonesian native herbs such as lemongrass (*sereh wangi* or *Cymbopogon winterianus*), cananga or ylang-ylang (*kenanga* or *Canarium odoratum*), and patchouli (*nilam* or *Pogostemon cabin*). This study aims to examine the effectiveness of a mixture of Indonesian essential oil made of lemongrass, cananga, and patchouli extracts. Experiment was conducted by asking a number of subjects to inhale the oil mixture and assessing its effectiveness in terms of psychological relaxation by using visual analog scale or VAS) and of physical relaxation by examining the subjects' blood pressure or mean arterial pressure (MAP), pulse frequency, and breathing frequency. The result was then compared with that of lavender oil and with the control group. The study was conducted on 60 healthy women through single-blind clinical trials (before and after) using the "intent to treat" approach, followed by a startle test. Participants were divided into three groups: (1) 20 participants who were treated with Indonesian essential oil mixture, (2) 20 participants who were treated with lavender oil, and (3) 20 participants who served as the control group. Psychological relaxation measurement showed that Indonesian essential oil mixture produced the same degree of effectiveness as lavender oil and the control groups did, although both treatments tended to produce better results than the control group did. However, physical relaxation measurement showed that Indonesian essential oil mixture produced a higher degree of effectiveness than lavender oil and tended to produce a better result than the control group did, especially in terms of blood pressure based on MAP scores.

Abstrak

Efektifitas Campuran Minyak Esensial Indonesia: Sereh Wangi, Kenanga, dan Nilam terhadap Relaksasi secara Inhalasi "Suatu Uji Klinis pada Wanita Sehat yang Memiliki Risiko Stress". Relaksasi merupakan salah satu mekanisme coping yang digunakan untuk menghadapi stress. Salah satu metode relaksasi yang banyak dipakai adalah aromaterapi dengan menggunakan minyak esensial. Minyak esensial yang berasal dari tanaman Indonesia yang bisa dimanfaatkan untuk relaksasi adalah sereh wangi, kenanga dan nilam. Penelitian ini bertujuan untuk melihat efektifitas campuran minyak esensial Indonesia yang terdiri dari sereh wangi, kenanga dan nilam yang diberikan secara inhalasi terhadap relaksasi secara psikologis dengan pengukuran *visual analog scale* (VAS) dan fisik dengan pengukuran tekanan darah atau *mean arterial pressure*, frekuensi nadi, dan frekuensi nafas serta dibandingkan dengan minyak lavender dan kontrol. Penelitian dilakukan dengan rancangan uji klinis tersamar tunggal, *before and after*, dengan perlakuan *intent to treat* yang dilanjutkan dengan tes kejutan pada 60 wanita sehat yang terdiri dari 20 subyek kelompok campuran minyak esensial Indonesia, 20 subyek kelompok lavender, dan 20 subyek kontrol. Penelitian ini memperlihatkan hasil bahwa campuran minyak esensial Indonesia memiliki efektifitas relaksasi secara psikologis yang sama dengan minyak lavender dan kontrol tetapi memiliki kecenderungan yang lebih baik dibandingkan dengan kontrol. Sedangkan secara fisik campuran minyak esensial Indonesia memiliki efektifitas relaksasi yang lebih baik dibandingkan dengan lavender dan kecenderungan yang lebih baik dibandingkan dengan kontrol terutama pada parameter tekanan darah atau MAP.

Keywords: aromatherapy, Indonesian essential oil mixture, psychological relaxation, physical relaxation, stress

Introduction

Relaxation is one of various strategies for coping with stress. Coping is defined as a process or effort of an individual to overcome or anticipate situations or conditions which might be potentially depressing and threatening, both physically and emotionally, and may pose a considerable burden beyond an individual's capacity to bear.¹ Relaxation also refers to an interventional technique which proves effective to treat various psychological problems and easy to apply in various settings, either individually or in groups.²

Tension and relax are physical conditions which involve sympathetic and parasympathetic nervous systems. When an individual feels threatened, frightened, or depressed, her/his sympathetic nervous system takes charge of the situation. As part of human emergency system, such mechanism is also known as "fight-or-flight" response system.³ When an individual enters a stressful condition, the system triggers sympathetic symptoms, four of which are the most prominent: (1) increasing level of heartbeat, blood pressure, and blood flow; (2) faster and shallower breath; (3) increasing level of mental activity; and (3) dramatic increase in muscle tension.²

Stress has also been found to affect a considerable number of nursing students. A study by Jones et al. (1997) showed that 50% of nursing students were experiencing stress.⁴ Another study by Kumar et al (2011) also showed that as many as 38% of nursing students aged 19–25 suffered from a high level of stress, of whom 35% were female students and 32% were senior students.⁵ A survey conducted in the United States revealed that women underwent more stress than males did (28% versus 20%), (American Psychological Association Survey, 2010)⁶ and that 48% of healthy women at college were susceptible to stress (mtvU AP Economy, 2009).⁷ Such findings show that two groups are more susceptible to stress: workers and nursing students aged between 19 and 25, especially senior students. Similar risk was also found even among healthy students at university level.

Aromatherapy and massage are ways to cope with stress and achieve relaxation which can be done at health centers and/or massage clinics. Both types of treatment have been clinically proven to offer significant therapeutic benefits.⁸ In a study by Kristanti (2010), residents of an elderly care house were given a lavender aromatherapy through inhalation, and this treatment was proven to have decreased their level of anxiety by 60%—a significant improvement in statistical terms.⁹ Another research by Dunn *et al.* (1995) compared the effectiveness of two different types of intervention: (1) a combination of lavender oil aromatherapy and massage and (2) only massage (as control group), each conducted

in 15–30 minutes. The research showed that there was a difference in clinical effects between the aromatherapy-plus-massage group and the control group, which revealed a significant reduction of anxiety in statistical terms.¹⁰

Essential oil for relaxation and aromatherapy can be derived from Indonesian native herbs such as cananga, lemongrass, and patchouli. The physiology of aromatherapy, with its alleged influence on human behavior and emotion and its role in inducing relaxation, remains a hypothesis, while the most accepted approach to proving it is through the examination of the limbic system, which is mostly affected by the aroma of the essential oil transmitted through the olfactory tract. The main chemical components of these oils have the potential of promoting relaxation. Linalool and geraniol of monoterpenoid alcohol group found in cananga and lemongrass oils can produce analgesic, relaxing, balancing, stimulatory, vasodilatory, and hypotensive effects.¹¹⁻¹² Citronellal of the aldehyde group, found in lemongrass oil, can produce analgesic, antidepressant, tonic, and stimulatory effects.^{11,13} Patchoulol found in patchouli oil produces stimulatory and sedative effects.¹¹⁻¹² In addition to suitable chemical components, essential oil for aromatherapy also requires a mixture of three kinds of oil which have different vaporization levels, consisting of "top to middle note" level (provided by lemongrass oil), "middle to base note" (provided by cananga oil), and "base note" (provided by patchouli oil), so that the aroma can be preserved in a much longer time.¹⁴

There are only few studies which investigate the application of aromatherapy for relaxation using oils extracted from Indonesian native herbs, and many of such studies were conducted by foreign scientists while their subjects were limited to healthy humans. A study conducted by Kim *et al.* (2010) featured lavender, chamomile, and sweet orange oils, but all of them are extracted from herbs not native to Indonesia.¹⁵ Another study by Rho *et al.* (2006) featured a combination of lavender, chamomile, rose, and lemon oils, of which only rose has been produced in Indonesia.¹⁶ No study has been conducted using lemongrass, patchouli or cananga oil, which are Indonesian native herbs, whereas some preclinical and small-scope clinical studies have empirically proven that these three oils actually contain substances which can promote relaxation in human. Therefore, such essential oils must be considered as potential resources which can be developed to increase the economic value of Indonesian native herbs.

This study seeks to examine the effectiveness of Indonesian essential oil mixture made of lemongrass, cananga, and patchouli extracts through inhalation in healthy women susceptible to stress; the mixture's

influence on human relaxation can be measured using physical parameters (blood pressure, pulse frequency, and breath frequency) and psychological parameter (using the instrument of visual analog scale or VAS). Measurement was taken before treatment, after treatment, and after a startle test, and all of these results were then compared to those obtained using lavender oil (comparison group) and non-aromatherapy massage (control group). Based on the findings, we hypothesize that our Indonesian essential oil mixture is effective for promoting physical and psychological relaxation in healthy human and that it is generally more effective than lavender oil and non-aromatherapy massage.

Methods

Research design. This research involved a single-blind clinical trial which (1) used a parallel design before and after, (2) featured three principal cases: a specific case (Indonesian essential oil mixture), a comparison case (lavender oil), and a control case (non-aromatherapy massage), and (3) applied the “Intent to Treat” approach to a number of healthy women as research subjects. The subjects were then assigned to three different treatment groups: the first group received an aromatherapy using an essential oil mixture made of three Indonesian native herbs (cananga, lemongrass, and patchouli), the first group received an aromatherapy using lavender oil, and the third group received a massage without aromatherapy (control group). Each treatment involved 20 subjects.

Research variable. Free variables of this research are lavender oil and Indonesian essential oil mixture made of cananga, lemongrass, and patchouli oils. Fixed variables of this research are (1) physical relaxation in three criteria: blood pressure or MAP, pulse frequency, and breath frequency and (2) psychological relaxation measured by visual analog scale (VAS). Control variable of this research is a massage technique called *efflurage*.

Research subjects. Subjects of the research were healthy female students of a nursing academy who fulfilled the following inclusion criteria: (1) susceptible to stress (awaiting for their final test, doing their college assignments, or undergoing their clinical practice); (2) having BMI (Body Mass Index) ≤ 30 , (3) having no history of chronic disease or not consuming medicine affecting the central nervous system, and (4) not consuming herbal medicine or certain types of supplements one week before and during the research. Exclusion criteria are (1) suffering from anosmia; (2) experiencing psychiatric symptoms, however light; and (3) during pregnancy or breastfeeding.

Test material. Test materials of this research were various types of pure essential oil: lavender, cananga,

lemongrass, and patchouli. These products were obtained from PT Martina Berto and held Certificate of Analysis (COA) and Material Safety Data Sheet (MSDS). Various mixtures of Indonesian essential oil had to undergo an initial preference test in order to determine the most suitable proportion of each oil type according to research purposes. Indonesian essential oil mixture and lavender oil were dissolved in a diffuser containing a 50 mL of aquabidest until reaching a suspension of 3%.

Research tools. This research utilized a number of main tools which consisted of a diffuser and several instruments to measure the degree of relaxation. The diffuser type was Ultrasound (brand: Aroma dot Ultrasmith[®] model KW-017) produced by PT. Ace Hardware Indonesia. Psychological relaxation was assessed using visual analog scale (VAS) instrument, while physical relaxation was assessed by mercury sphygmomanometer (brand: Fujito[®]) to measure blood pressure and a stop watch (brand: Omron[®]) to measure pulse and breath frequencies. Sound intensity was measured by an electronic decibel meter.

Panel test of preference degree and relaxation benefit. The main substance examined in this study was Indonesian essential oil mixture made of three oil types with three different ratios. The ratio of lemongrass oil to cananga oil to patchouli oil is represented as v/v/v. The three oils were mixed in three different ratios: (a) 1:1:1, (b) 1:2:2, and (c) 1:3:3. 3% of soy oil was then added to all mixtures as solvent. The solutions were then transferred to 10mL-size bottles indicated with labels a, b, and c. 30 respondents were then invited to participate in the panel test and were asked to inhale all the three samples one after another and to grade each solution in order from 1 to 3. The results were then recorded in a table and subsequently analyzed by totaling the number of grade 1 given to each sample. The result's validity was then reexamined using rank statistical test (the Friedman Analysis).

Method. Subjects of the research were 60 healthy women who had to pass a recruitment process. They then had to undergo a simple randomization process, each were assigned a random number. The subjects were to receive either Indonesian essential oil mixture aromatherapy with *afflurage* massage, lavender oil aromatherapy with *afflurage* massage, or only *afflurage* massage. Before the experiment, the subjects were divided into three treatment groups consisting of 20 subjects each: (1) test group, (2) comparison group, and (3) control group. The three groups received different treatments: (1) the test group received Indonesian essential oil mixture aromatherapy plus *afflurage* massage; (2) the comparison group received lavender oil aromatherapy plus *afflurage* massage; and (3) the control group received only *afflurage* massage without

aromatherapy. The treatment was conducted in a closed room with air conditioner. The first data set was obtained by measuring the subjects' blood pressure, breath frequency, pulse frequency, and by asking them to fill in the VAS questionnaire. Then, intervention was initiated by providing (or not providing, in the case of the control group) the subjects with specific types of aromatherapy: the first group used Indonesian essential oil mixture, the second group used lavender oil, and the third group did not use any essential oil. The subjects of the first and second groups then received *efflurage* massage with a special massage oil for 20 minutes while enjoying the aromatherapy emitted by the diffuser, while the subjects of the third (control) group only received a 20-minute massage without enjoying any aromatherapy. After treatment, the subjects were once again asked to fill in the VAS questionnaire. All subjects were then asked to take a five-minute rest to readapt their bodies while listening to some music using an earphone. After that, the subjects received another physical examination to check their blood pressure, pulse frequency, and breath frequency. The subjects then had to undergo a startle test using a sound of gunshot for 30 seconds, which was immediately followed by another examination of blood pressure, pulse frequency, and breath frequency. The subjects were then asked to take another five-minute rest to readapt their bodies before filling in another VAS questionnaire and receiving another examination of blood pressure, pulse frequency, and breath frequency. Each subject had to undergo all interventions in a single day in order to avoid bias caused by subjectivity: the researcher might be influenced by the intervention that s/he had administered to the previous subject.

Statistical analysis. All data collected from the research were processed using a computer with two programs: Microsoft Excel and SPSS 13 for univariate and bivariate analyses. Univariate analysis was used for processing descriptive data by examining four things: (1) average differences, (2) standard deviations, (3) lowest and highest scores, and (4) estimation value with 95% sensitivity. Bivariate was used for examining two things: (1) the difference of average scores between pre- and post-treatment using paired student t-test and (2) the difference of average scores between two groups using independent t-test.

Results and Discussion

Panel test of preference degree and relaxation benefit. At the initial stage of this research, a panel test was conducted to examine the degree of preference and the benefit of relaxation in order to determine the best proportion of each type of Indonesian essential oil to be used in the experiment proper. 30 respondents were involved in the test. The result of this panel test showed that mixture number 3 obtained the highest average

score in both preference panel (2.3) and benefit panel (2.37) and showed a significant statistical difference ($p < 0.05$) in both preference and benefit panels when compared to the other two mixtures. Therefore, the mixture number 3 was chosen for the experiment proper (see Table 1). Mixture number 3 has the ratio of 1:3:3 with this following distribution: 1 for lemongrass oil, 3 for cananga oil, and 3 for patchouli oil (v/v/v).

The result of preference degree and relaxation benefit test showed more preference towards the mixture of lemongrass, cananga, and patchouli oils with a ratio of 1:3:3 (v/v/v).

Such proportion helps neutralize the strong smell of lemongrass oil due to its significant terpenoid content in the form of citronellal (up to 55%).¹¹ After the oil mixture had been diluted to 3%, a chemical compound measurement was conducted to calculate citronellal concentration in the mixture, which yielded a final figure of 0.23%. It follows from this result that 0.23% was the most preferred concentration of citronellal in an essential oil mixture, thus making it the most suitable substance for aromatherapy.

Effectiveness of essential oil in psychological relaxation. The increasing level of psychological relaxation (as shown by calculating the difference between pre- and post- treatment VAS scores) showed that the application of essential oil in aromatherapy really brought significant benefits to all three groups.

All three treatments (Indonesian essential oil mixture, lavender oil, and non-aromatherapy massage) were able to induce certain degree of psychological relaxation, but lavender oil had a higher effectiveness in terms of psychological relaxation than Indonesian essential oil mixture and non-aromatherapy massage did. Similar results were also shown by a study by Hongratanaworakit *et al.* (2006) which used VAS instrument to prove that aromatherapy (with cananga oil) could induce psychological relaxation in human subjects with a score difference of 13 mm.¹⁷ The current research showed that no substantial difference was found between Indonesian essential oil mixture, lavender oil, and non-aromatherapy massage in terms of psychological relaxation. This also showed that any kinds of intervention could actually produce similar psychological effect (relaxed and peaceful feelings), although there was also a tendency that the psychological benefit of treatment can be enhanced by adding aromatherapy to the *efflurage* massage. The best result was achieved by lavender oil, followed by Indonesian essential oil mixture.

Relaxation achieved by massage can be explained in terms of human physiological mechanism, particularly the limbic system. Firstly, massage generates certain bodily signals which are transmitted through the limbic

Table 1. Average Scores of Preference Degree and Relaxation Benefit of Three Mixtures of Indonesian Essential Oil

	Mixture 1 (n = 30)		Mixture 2 (n = 30)		Mixture 3 (n = 30)		p value *
	Average	SD	Average	SD	Average	SD	
Preference Degree Panel	1.63	0.81	2.13	0.68	2.3	0.85	0.045
Relaxation Benefit Panel	1.67	0.80	1.97	0.67	2.37	0.85	0.025

*p *Friedman Test*; $\alpha = 0.05$; n = number of respondents for each mixture; SD = standard deviation

Table 2. Comparison of the Degree of Psychological Relaxation Measured through VAS Score Obtained before Treatment, after Treatment, and Five Minutes after Startle Test for Each Group

	Indonesian Essential Oil Mixture (n = 20)		p value	Lavender Oil (n = 20)		p value	Control treatment (n = 20)		p value *
	Average	SD		Average	SD		Average	SD	
After Relaxation									
Base VAS Score	54	14.65	0.00	51.4	19.95	0.00	61.25	15.37	0.00
T1 VAS Score	76.25	12.96		81.8	10.26		80.2	15.44	
5 Minutes after Startle Test									
T1 VAS Score	76.25	12.96	0.92	81.8	10.26	0.37	80.2	0.85	0.84
T3 VAS Score	76	14.47		84.1	14.04		79.5	0.85	

*p *Paired t-test*; $\alpha = 0.05$

Note: VAS = Visual Analog Scale; Base = initial measurement; T1 = measurement after treatment, n = number of research subjects in each treatment; SD = standard deviation; average = average score of each treatment

Table 3. Comparison of Degree of Psychological Relaxation (Difference of VAS Average Score) between Indonesian Essential Oil Mixture Group, Lavender Oil Group, and Control Group

Time of Measurement	Indonesian Essential Oil Mixture (n = 20)		Lavender Oil (n = 20)		p value *
	Average Difference	SD	Average Difference	SD	
$\Delta T1 - Base$	22.25	14.99	30.4	15.67	0.10
$\Delta T3 - T1$	-0.25	11.29	2.3	11.27	0.48
$\Delta T3 - Base$	22	18.09	32.7	21.39	0.09
Time of Measurement	Indonesian Essential Oil Mixture (n = 20)		Control Treatment (n = 20)		p value *
	Average Difference	SD	Average Difference	SD	
$\Delta T1 - Base$	22.25	14.99	18.95	13.43	0.47
$\Delta T3 - T1$	-0.25	11.29	-0.7	15.33	0.92
$\Delta T3 - Base$	22	18.09	18.25	18.86	0.53
Time of Measurement	Lavender Oil (n = 20)		Control Treatment (n = 20)		p value *
	Average Difference	SD	Average Difference	SD	
$\Delta T1 - Base$	30.4	15.67	18.95	13.43	0.02
$\Delta T3 - T1$	2.3	11.27	-0.7	15.33	0.49
$\Delta T3 - Base$	32.7	21.39	18.25	18.86	0.03

p value* *Independent t Test*

Notes: Base = initial measurement; T1 = measurement after treatment; T3 = measurement 5 minutes after startle test (after adaptation); n = number of subjects in each treatment; SD = standard deviation

system. The signals then stimulate the neuromuscular junction (muscle motor end plate) and are further transmitted to the spinal cord (*medulla spinalis*) and the brain. In the brain, the signals are carried to the hypothalamus and the amygdala, thus affecting the emotional center of the limbic system.¹⁸ The subjects were then given a stress provocation by startle test, but subsequent measurement of psychological relaxation indicated that the startle test did not trigger any significant psychological change in all treatment groups (Indonesian essential oil mixture, lavender oil, and non-aromatherapy massage). This might happen because the subjects had supposedly acquired a maximum degree of psychological relaxation; therefore, the stressor (sound of gunshot), which can provoke stress in healthy human under normal circumstances, cannot instantly change the subjects' emotional state.

Effectiveness of essential oil in physical relaxation.

Relaxation can be said to happen when a significant decrease of Mean Arterial Pressure (MAP) is achieved, and this occurred in Indonesian essential oil mixture group and control group after treatment. However, the lavender oil group did not show any significant MAP decrease after relaxation. No group showed any significant decrease of pulse and breath frequencies. Five minutes after startle test, no change of MAP and pulse frequency was recorded in all groups, but there was a significant difference between the post-treatment measurement and post-startle test measurement in Indonesian essential oil mixture group. This means that all subjects reverted to their post-treatment condition (see Table 4). Decrease of MAP was more prominent and more statistically significant in Indonesian essential oil group than in lavender oil group. The result is almost similar when compared to the control group, although it was not statistically significant. The most substantial decrease of pulse frequency was recorded in Indonesian essential oil mixture group, compared to that in lavender and control groups, despite not statistically significant. Lavender and control groups both showed a similar level of decrease in MAP and pulse frequency, even though the control group showed a higher decrease in MAP and the lavender group showed a higher decrease in pulse frequency, both of which, however, were not statistically significant. Five minutes after startle test, Indonesian essential oil mixture group showed a higher increase of MAP than lavender group did. Moreover, Indonesian essential oil mixture group also had a higher difference of MAP average score and pulse frequency than the control group did, despite not statistically significant; however, its difference of average pulse frequency was statistically significant. Indonesian essential oil mixture group did not show any significant increase in pulse frequency compared to that in lavender group, while lavender and control groups showed the same result. Both lavender and control groups did not show a significant difference of pulse frequency

decrease. In terms of breath frequency, the difference in average scores of all treatments was almost zero (see Table 5).

These results showed that the application of Indonesian essential oil mixture and massage can produce certain degree of physical relaxation, as shown by the MAP parameter. However, no significant relaxation was achieved in terms of pulse and breath frequencies by all kinds of treatment, even though the application of Indonesian essential oil mixture did bring some physical relaxation, which was demonstrated by a change in pulse frequency. The control group did not show a significant decrease of pulse frequency, which was probably because the pulse frequency had achieved a maximum degree of relaxation. No treatment generated any reaction in terms of breath frequency. Similar result was reported by Antony (2006) which found that aromatherapy brought a significant physical relaxation effect on human sympathetic system, as shown by systolic and diastolic measurements, even though pulse and breath frequencies did not undergo any significant change.¹⁹ In a similar vein, studies conducted by Kim *et al.* (2010) and Chang *et al.* (2010), using different kinds of essential oil, did record a significant change in blood pressure and pulse frequency but no change in breath frequency.^{15,20} This proves that aromatherapy through inhalation does bring significant effect on human sympathetic system, particularly in terms of blood pressure and pulse frequency.

Furthermore, this research showed an immediate increase of MAP after startle test in Indonesian essential oil mixture and control groups, while all groups showed an increase in pulse frequency, which demonstrated that increase occurred in almost all parameters except breath frequency. These findings implied that relaxation will be less effective when stress provocation is given, and this holds true with aromatherapy, as well as with any other kinds of treatment. Similar response was also reported by Lynch *et al.* (2009) which showed that sympathetic system (pulse frequency) was still affected by startle test even though the subjects had attained relaxation by continuous exposure to classical music.²¹ Even though the Indonesian essential oil group showed a more significant sympathetic effect, shown by some change in MAP and pulse frequency, it was still lower than that achieved through non-aromatherapy massage.

Five minutes after the startle test (re-adaptation period), all subjects reverted to their previous physical condition after treatment, especially in terms of MAP and pulse frequency. This shows that a five-minute re-adaptation is sufficient to bring subjects back to their post-treatment condition (before the startle test was administered). Indonesian essential oil group was the only group which could not return to post-treatment condition five minutes after startle test, even though it

did not plunge to their pre-treatment condition. This showed that, in general, treatment can help buffer an individual against potential stress and enable her/him to gradually return to relaxed condition. This stressor defense mechanism has not been sufficiently investigated, but the most plausible explanation is the connection of reticular system (*formatio reticularis*) in the brainstem with cerebrum cortex and autonomous nervous system. First, aroma is received by the olfactory bulb (*bulbus olfactorius*) and transmitted to the cerebrum cortex and hypothalamus in the limbic system. Hypothalamus then transmits the signals to reticular system in the brainstem, and from here they are further transmitted via the efferent fiber to autonomous nervous system in the spinal cord (*medulla spinalis*), from which they modulate the cardiovascular control center of medulla oblongata.²²

This research also found that Indonesian essential oil mixture offered a more significant physical benefit than lavender oil did, especially in terms of MAP. Even though the difference of pulse frequency change in both treatments was not particularly high, Indonesian essential oil mixture still produced a slightly better result (see Table 5). However, when compared with non-aromatherapy massage, Indonesian essential oil mixture was no more effective since the difference of

change between both treatments was very slight. However, clinical test showed that Indonesian essential oil mixture can actually produce a better result, especially in terms of MAP and pulse frequency, while lavender oil and non-aromatherapy massage offered the same degree of physical relaxation, as shown by MAP and pulse frequency measurements (see Table 6).

According to human physiology, breath frequency, as a parameter of physical relaxation, should have been affected by aromatherapy or massage because the signals are supposed to influence the limbic system and modulate sympathetic nervous system, thus decreasing breath frequency and producing relaxation. However, there was no such effect after treatment, after startle test, and five minutes after startle test. Antony *et al.* (2006) and Hongratanaworakit *et al.* (2006), both utilized lavender oil, also obtained the same result concerning breath frequency change.^{17,19} These all showed that the chemical arrangement of aromatherapy oil and non-aromatherapy massage were not adequate for producing any demonstrable effect on human parasympathetic nervous system through the limbic system and that breath frequency as a parameter was sensitive enough to gauge the activity of autonomous nervous system. Hence, breath frequency is not recommended as a parameter of physical relaxation.

Table 4. Effectiveness of Essential Oil in Physical Relaxation (MAP, Pulse Frequency, Breath Frequency) before Treatment, after Treatment, and Five Minutes after Startle Test for Each Group

	Indonesian Essential Oil Mixture (n = 20)		p value *	Lavender Oil (n = 20)		p value *	Control Treatment (n = 20)		p value *
	Average	SD		Average	SD		Average	SD	
After relaxation									
MAP Base	83.49	10.26	0.02	76.50	5.23	0.73	84.50	10.04	0.04
MAP T1	75.75	7.67		76.25	6.06		78.67	7.68	
Base Pulse Frequency	73.40	13.13	0.09	67.00	9.52	0.77	69.20	9.46	0.68
T1 Pulse Frequency	68.40	7.44		65.00	18.09		70.20	10.58	
Base Breath Frequency	15.90	1.37	0.29	15.50	1.39	0.89	15.60	1.14	0.31
T1 Breath Frequency	15.50	1.23		15.55	1.23		15.85	0.88	
5 Minutes after Startle Test									
T1 MAP	75.49	10.28	0.00	76.25	5.23	0.10	78.67	10.05	0.39
T3 MAP	80.17	7.45		74.42	6.08		77.33	6.80	
T1 Pulse Frequency	68.40	13.44	0.92	65.60	9.53	0.24	70.20	9.46	0.81
T3 Pulse Frequency	68.60	5.39		70.15	9.09		68.60	5.39	
T1 Breath Frequency	15.55	1.36	0.72	15.55	1.39	1.00	15.85	0.88	0.59
T3 Breath Frequency	15.70	1.13		15.55	0.69		15.70	0.64	

*p Paired Sample t-Test; $\alpha=0,05$

Notes: Base = initial measurement; T1 = measurement after treatment;

T3 = measurement 5 minutes after startle test (after adaptation); MAP = Mean Arterial Pressure; n = number of research subjects in each treatment; Average = average measurement of each treatment; SD = standard deviation.

Table 5. Comparison of Degree of Physical Relaxation between Indonesian Essential Oil Mixture Group and Lavender Oil Group (n=20)

Variable	Time of Measurement	Indonesian Essential Oil Mixture		Lavender Oil		p value*
		Average Difference	SD	Average Difference	SD	
Mean Arterial Pressure (MAP)	$\Delta T1 - Base$	-7.75	13.05	-0.25	3.16	0.02
	$\Delta T3 - T1$	4.42	5.36	-1.83	4.70	0.00
	$\Delta T3 - Base$	-3.33	12.23	-2.08	4.62	0.67
Pulse Frequency	$\Delta T1 - Base$	-5.00	12.64	-1.40	20.94	0.51
	$\Delta T3 - T1$	0.20	8.60	4.50	16.89	0.31
	$\Delta T3 - Base$	-4.80	12.62	3.15	11.42	0.04
Breath Frequency	$\Delta T1 - Base$	-0.40	1.64	0.05	1.70	0.39
	$\Delta T3 - T1$	0.15	1.81	0	0.97	0.74
	$\Delta T3 - Base$	-0.25	1.86	0.05	1.47	0.58

p* Independent t-Test; $\alpha = 0,05$

Notes: Base = initial measurement; T1 = measurement after treatment; T3 = measurement 5 minutes after startle test (after adaptation); SD = standard deviation; n = number of research subjects in each treatment

Table 6. Comparisons of Degree of Physical Relaxation between (1) Indonesian Essential Oil Mixture Group and Control Group and (2) Lavender Oil Group and Control Group (n=20)

Variable	Time of Measurement	Indonesian Essential Oil Mixture		Control Treatment		p value*
		Average Difference	SD	Average Difference	SD	
MAP	$\Delta T1 - Base$	-7.75	13.05	-5.83	8.08	0.58
	$\Delta T3 - T1$	4.42	5.36	-1.33	6.70	0.74
	$\Delta T3 - Base$	-3.33	12.23	-7.17	8.26	0.25
Pulse Frequency	$\Delta T1 - Base$	-5.00	12.64	1.00	10.60	0.11
	$\Delta T3 - T1$	0.20	8.60	-1.60	5.80	0.00
	$\Delta T3 - Base$	-4.80	12.62	-0.60	10.72	0.26
Breath Frequency	$\Delta T1 - Base$	-0.40	1.64	0.25	1.07	0.38
	$\Delta T3 - T1$	0.15	1.81	-0.15	1.25	0.54
	$\Delta T3 - Base$	-0.25	1.86	0.10	1.80	0.79

Variable	Time of Measurement	Lavender Oil		Control Treatment		p value*
		Average Difference	SD	Average Difference	SD	
MAP	$\Delta T1 - Base$	-0.25	3.16	-5.83	8.08	0.07
	$\Delta T3 - T1$	-1.83	4.77	-1.33	6.70	0.79
	$\Delta T3 - Base$	-2.08	4.62	-7.17	8.26	0.02
Pulse Frequency	$\Delta T1 - Base$	-1.40	20.94	1.00	10.60	0.65
	$\Delta T3 - T1$	4.55	16.89	-1.60	5.80	0.17
	$\Delta T3 - Base$	3.15	11.42	-0.60	10.72	0.29
Breath Frequency	$\Delta T1 - Base$	0.05	1.70	0.25	1.07	0.66
	$\Delta T3 - T1$	0	0.97	-0.15	1.25	0.67
	$\Delta T3 - Base$	0.05	1.47	0.10	1.80	0.92

p* Independent t-Test; $\alpha = 0,05$;

Notes: Base = initial measurement; T1 = measurement after treatment; T3 = measurement 5 minutes after startle test (after adaptation); SD = standard deviation; n = number of research subjects in each treatment

Conclusions

Indonesian essential oil mixture made of lemongrass, cananga, and patchouli oils has been proven to promote relaxation in healthy women with great potential for stress. Indonesian essential oil mixture was effective for inducing physical relaxation, particularly in terms of Mean Arterial Pressure (MAP) and pulse frequency, but not in terms of breath frequency. Indonesian essential oil mixture and lavender oil may induce a similar degree of psychological relaxation, while the same also holds true for Indonesian essential oil mixture and non-aromatherapy massage. However, Indonesian essential oil mixture tended to induce a higher degree of psychological relaxation than any other treatments without aromatherapy. According to the difference of average MAP scores, Indonesian essential oil mixture could promote a higher degree of physical relaxation than lavender oil and non-aromatherapy massage, although the difference was only slight when compared with the latter treatment. However, the effectiveness of essential oils and non-aromatherapy massage in terms of physical relaxation remained the same based on post-treatment measurement.

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