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# The aromatherapy formulation of essential oils in reducing stress and blood pressure on human

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**Abstract.** Unhealthy lifestyles such as low physical activity, unbalanced nutrition consumption, high workloads, and low emotional management make a person vulnerable to stress. The large-scale lockdowns to reduce COVID-19 transmission also exacerbate the stress level. Regarding organic and complementary therapeutic schemes, both increased relaxation and decreased hypertension are carried out using aromatherapy that involves essential oil formulations. This study aims to identify the characteristics and effects of aromatherapy formulations, including benzoin, nutmeg, and citronella essential oils on relaxation and human blood pressure. The study began by identifying local applications of essential oils through interviews with 20 local people who apply essential oil in their remedies. The method included initial and final measurements of blood pressure in aromatherapy application for three consecutive days. To evaluate aromatherapy profiles, forty respondents were selected purposively and asked about their expression after inhalation. The results showed that application of the aromatherapy formulation reduced systolic pressure by 8.5 mmHg and diastolic pressure by 1.2 mmHg. Most of the respondents considered that the aroma of formulated essential oils has a refreshing and calming effect on their mind. These antidepressant effects are obtained from combination of benzyl cinnamate, geraniol, linalool, myristicin, p-cymene etc in formulated essential oils. This research concluded that inhalation of essential oils formulation provided a relaxing effect and reduced hypertension, significantly.

## 1. Introduction

The global Covid-19 pandemic affects all aspects of human life, including the economy, health, social, technology and environment. Large scale lockdowns on social life bring certain responses that affect the quality of human life, such as changes in lifestyle and disturbing anxiety [1]. Restrictions result in reduced physical activities, on the other hand, increased consumption of unbalanced nutrition, high workloads, and low emotional management make a person vulnerable to stress and depression. The stress affects feeling, cognitive, and behavior, but also causes various body problems such as fatigue, shaking, sleep problems, headaches, high blood pressure or problems with heart rhythm [2]. Recently, various efforts have been made to overcome this mental illness, including encouraging relaxation of the mind through the use of aromatherapy which involves the formulation of essential oils.

The application of aromatherapy for health is in line with the development of medical science for centuries around the world [3]. Aromatherapy utilizes essential oils to improve levels of human health and well-being both physical and emotionally. Essential oils are extracted from leaves, flowers, fruits, seeds, bark, stems, roots, or resin of plants. This organic oil contains phytochemical compounds with



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specific aromas that promote anti-bacterial, anti-viral, anti-inflammatory properties, as well as boost the immune system, improve blood circulation and affect emotions with a calming effect [3-5]. Various local wisdoms in Indonesia have also utilized this important compound for various remedies and relaxation for the body and mind [6]. Recent findings show that essential oils are able to boost the immune system, thereby helping to prevent and combat diseases that attack the human respiratory system [4,7].

This study aims to identify the characteristics and effects of aromatherapy formulations, including benzoin (*Styrax sumatrana*), nutmeg (*Myristica fragrans*), and citronella (*Cymbopogon nardus*) essential oils on human especially in reducing stress and blood pressure while increasing relaxation. The information obtained is expected to explore the excellent potential of local essential oil applications for further scientific studies in the discovery of new natural constituents of interest in therapy and herbal medicine.

## 2. Materials and Methods

### 2.1. Materials

The materials included several pure essential oils i.e. benzoin, nutmeg, citronella and carrier oils. Benzoin oil was extracted from *Styrax sumatrana* resin harvested from community forests in Humbang Hasundutan, Lake Toba region, North Sumatra, while nutmeg oil was distilled from nutmeg mace (*Myristica fragrans*) from South Aceh. Citronella oil was distilled from the citronella plant (*Cymbopogon nardus*). Furthermore, the equipment used was a steam distillatory, an inhaler, some erlenmeyer bottle 100 mL and a blood pressure measurement device.

### 2.2. Methods

The study began by identifying local applications and phytochemicals of several essential oils used in cardiovascular medicine and anti-depressants. The activities were conducted through interviews with 40 local peoples that applied essential oils in their treatment in Karo and Toba of North Sumatra; and Acehese in Singkil and South Aceh during 2020. Respondent characteristics including gender and age were considered and recorded. The benefits of essential oils were verified by referring to various identification both phytochemical content and pharmacological activities [6].

In this study, aromatherapy products were composed of three combinations of essential oils with several concentrations (Table 1). Based on the formulation, the oils were mixed into a 100 mL glass cup, then stirred until the entire mixture becomes homogeneous [8].

**Table 1.** Formulation of aromatherapy products.

Formula	Volume (mL) (%)				Total
	Citronella (topnote)	Nutmeg (middlenote)	Benzoin (base-note)	Carrier oil (Sun Flower)	
F1	5 (12.5)	15 (37.5)	10 (25.0)	10 (25.0)	40 (100)
F2	10 (25.0)	10 (25.0)	10 (25.0)	10 (25.0)	40 (100)
F3	15 (37.5)	5 (12.5)	10 (25.0)	10 (25.0)	40 (100)

To evaluate aromatherapy product profiles, forty respondents were inquired about their expression on sensation after inhalation, sensitivity, and aroma of each tested formulas. Respondents were selected by considering the gender with age range of 40 to 60 years old. The importance of each profile was defined conforming to a Likert scale: high (favourable); moderate; and low (untolerable). The research method also included initial and final measurements of blood pressure in the aromatherapy formulation application for three consecutive days.

### 3. Results and Discussion

#### 3.1. Local application

This research recognized three essential oils commonly used in treatments for hypertension as well as reducing stress and refreshing body and mind. The essential oils consist of citronella (*Cymbopogon nardus*), nutmeg (*Myristica fragrans*), and benzoin (*Styrax sumatrana*) oils. Traditionally, these oils are also used for certain disorders including relieving muscular pain, digestive problems, as well as diabetes mellitus and liver disorders. Furthermore, this organic oil is applied to reduce stress, insomnia and respiratory disorders such as asthma.

In local communities in South Aceh, nutmeg oil has an important role in daily medicine. This oil has been known since ancient times as a versatile remedy for treating physical and mental illnesses and disorders such as treating arthritis by massaging the painful joints with a few drops of oil. Nutmeg oil has also anti-inflammatory properties that help treat rheumatism, tooth and gum pain and aches. A few drops of oil are mixed with a spoonful of honey to treat indigestion, diarrhea and the digestive tract (gastroenteritis). This organic oil has analgesic properties and is applied to relieve congested nose, cough, sore throats, and insomnia.

Traditionally, benzoin oil is widely recommended as a cure for tumors, ulcers, vomiting, dysentery, fever and muscular pain. In local medicine, benzoin resin is also burned to cure smallpox, and the vapors are inhaled to treat coughs and shortness of breath. The rituals of worship also apply a lot of resin considering their calming and concentration-boosting effects. However, the local wisdom of essential oils utilization for daily remedy is relatively limited, especially only for the elderly. Referring to the respondents who use essential oils, most of them are more than 50 years old (78%) and dominated by women (85%). In the long term, this has implications on the loss of local wisdom in using organic medicine and alternative therapy in the local community.

Essential oils are derived from a variety of plants parts (Table 2). Citronella oil is produced from the distillation of the stems, leaves and roots of *Cymbopogon nardus*. Nutmeg oil is generally extracted from nutmeg's mace, although the flowers and seeds also contain significant level. Meanwhile, benzoin oil is extracted from the resin of an endemic styrax tree that grows in Lake Toba region [9].

Essential oils are generally used by massage (topical), inhalation (olfactory), or consumed internally. Inhalation and massage are often applied to refresh a tired body and mind by the local community. Consumption of nutmeg and citronella oils in certain doses is believed to treat and relieve the symptoms of digestive disorders.

**Table 2.** Application and source of essential oil.

Essential oils	Sources					Application		
	Leaves	Flowers	Fruits	Roots	Resin	Massage	Olfactory	Consumed
Citronella	√			√		√	√	√
Nutmeg		√	√			√	√	√
Benzoin					√		√	

These health benefits are explained by the particular phytochemical compounds contained in each essential oil. Benzoin oils contain some distinctive flavored and efficacious volatile compounds such as benzoic acid, cinnamic acid, benzyl benzoate, benzyl cinnamate, styrene, cinnamyl benzoate, (E)-cinnamyl-(E)-cinnamate, allyl benzoate, benzaldehyde, ethyl benzoate, eugenol, (E)-cinnamaldehyde, allyl cinnamate, and 1,8-cineole [10]. Most of these pleasant-smelling compounds are processed in the perfumery, flavorings, and food preservative industries. Furthermore, nutmeg essential oil contains sabinene,  $\beta$ -pinene,  $\alpha$ -pinene, terpinen-4-ol, elemicin, myristicin, limonene,  $\beta$ -phellandrene,  $\beta$ -myrcene, 3-carene, terpinolene,  $\alpha$ -terpineol, p-cymene, methyl eugenol,  $\alpha$ -thujene,  $\beta$ -caryophyllene,  $\alpha$ -copaene, citronellol, geranyl acetate, and camphene [11]. Meanwhile, phytochemical compounds such as citronellal, geraniol, geranyl acetate and limonene are identified in citronella oils. Some phytochemical compounds such as p-cymene, limonene,  $\beta$ -caryophyllene, eugenol, benzyl cinnamate,

cinnamic acid, styrene benzoic acid, benzyl benzoate, geranyl acetate, and geraniol, were identified as the main components that are responsible for the smell of mixed essential oils from aromatherapy product. These compounds are also considered to reduce anxiety and stress [10,11].

### 3.2. Aromatherapy profiles

Aromatherapy profiles based on the assessments of forty respondents regarding their expression of the product formulations tested are shown in Table 3.

**Table 3.** Profile of aromatherapy product.

Formula	Gender	Sensation after inhalation			Sensitivity			Aroma		
		high	moderate	low	high	moderate	low	high	moderate	low
F.1	Male	35.0	30.0	35.0	27.5	35.0	37.5	32.5	27.5	40.0
	Female	40.0	40.0	20.0	32.5	35.0	32.5	37.5	32.5	30.0
	Average	37.5	35.0	27.5	30.0	35.0	35.0	35.0	30.0	35.0
F.2	Male	42.5	35.0	22.5	35.0	37.5	27.5	37.5	32.5	30.0
	Female	47.5	40.0	12.5	40.0	42.5	17.5	42.5	37.5	20.0
	Average	45.0	37.5	17.5	37.5	40.0	22.5	40.0	35.0	25.0
F.3	Male	30.0	32.5	37.5	30.0	32.5	37.5	27.5	32.5	40.0
	Female	40.0	37.5	22.5	35.0	37.5	27.5	37.5	37.5	25.0
	Average	35.0	35.0	30.0	32.5	35.0	32.5	32.5	35.0	32.5

Most of the respondents expressed a high preference for sensation after inhalation with a refreshing aroma, as well as low sensitivity especially to a slightly pungent aroma (Table 3). Among the three-aromatherapy formulation, formula 2 produces the highest preference for sensation after inhalation sensation (45%), aroma profile (40%), and the lowest sensitivity level (22.5%).

The first sensation derived from the top-note and middle-note scents; volatile compounds from citronella and nutmeg oils. A slightly pungent citrus-like fragrance comes from *p-cymene* and *limonene*. Initially, the compounds which also contained in eucalyptus and camphor oils [14] have a strong and irresistible aroma, but once mixed with benzoin oil, the resulting aroma becomes more acceptable. Limonene and p-cymene compounds have been identified as efficacious to relieve and reduce anxiety, stress, depression and refresh the mind [15,16]. A particular scent such as turpentine but softer from a-pinene and b-pinene is also detected as an initial sensation [15,16]. These compounds are identified to reduce inflammation, improve cognitive function, and reduce anxiety. However, at higher concentrations, these four compounds produce a pungent and intolerable aroma with a nose-piercing sensation.

After a while, a sweet and spicy honey-like balsamic aroma derived from the benzoin oil also spreads. The odor was induced by benzyl cinnamate, cinnamic acid, styrene, and benzoic acid [8,10,17], while a unique aroma like sweet almond with floral but slightly pungent identified as allyl benzoate and benzaldehyde [8,10]. These compounds were processed in perfumery and flavoring industry, generally. Moreover, the compounds of b-caryophyllene and eugenol produce a distinctive warm spicy pungent odor which similar to clove and cinnamon oil scents. These phytochemicals were identified as anti-inflammatory with strong antioxidant properties that can reduce cholesterol, and help relieve muscle and joint pain and anxiety[18]. Compounds that have received recent global attention in the COVID-19 treatment are also found in essential oil blends. The mild aroma of 1,8-cineole has antiviral, antibacterial, and antifungal properties, as well as the potential to heal the respiratory system and to increase the immune system.

Gender affects preferences for the aroma of formulated essential oils. Women have a higher sensation after inhalation of pleasant smells, on the other hand, are more sensitive to more pungent smells (Table 3). The difference in olfactory sensitivity in men and women is influenced by their roles in social behavior and is associated with a person's perception of smell. This is associated with experiences and associated emotions. However, the results of the isotropic tractator test found that the difference in olfactory sensitivity had biological roots. The number of cells in the olfactory bulb in

brain structure of women is an average of 43 percent more than men. Moreover, women have about 50 percent more neurons [19]. The olfactory bulbs and their neurons are responsible for the process of receiving aromas in the brain. Several studies using electrophysiological recordings of event-related potentials confirmed the superiority of women in odor detection and emotional valence [17,18].

### 3.3. Reduce anxiety and blood pressure

The results showed that application of the aromatherapy formulation reduced systolic pressure by 8.5 mmHg and diastolic pressure by 1.2 mmHg. Most of the respondents considered that aroma of formulated essential oils has a refreshing and calming effect on the mind. This research concluded that inhalation of formulated essential oils provides a relaxing effect and reduce hypertension, significantly.

**Table 4.** Result of blood pressure measurement before and after aromatherapy application.

Blood pressures	Gender	Initial (mmHg)	After (mmHg)	Decrease (mmHg)
systolic	Male	134.2	125.6	8.6
	Female	125.6	117.2	8.4
	Average	129.9	121.4	8.5
diastolic	Male	89.3	88.0	1.3
	Female	82.5	81.4	1.1
	Average	85.92	84.72	1.2

The results showed that the initial measurement of the blood pressure of men was relatively higher than women. The average diastolic and systolic pressures of men reached 89.3 and 134.2 mmHg respectively. This condition shows that men aged 40-60 years are more susceptible to hypertension than women. After the application of aromatherapy, the blood pressure of both men and women decreased significantly. In men, systolic and diastolic pressures decrease to 8.6 and 1.3 mmHg respectively. Meanwhile, for women, the application of blending essential oil reduces systolic and diastolic pressure to 8.4 and 1.1 mmHg respectively. Although the gender response to the application of aromatherapy to lower blood pressure is relatively no different, the results show that the inhalation method using essential oils can be considered as an effective treatment intervention to reduce the psychological stress and blood pressure in people with hypertension.

The practice of aromatherapy to reduce blood pressure is related to essential oil ability to reduce anxiety and stress [21]. Inhaled essential oil aroma affect biochemical processes in limbic system of brain, especially on endocrine and immune systems [13,18]. These olfactory stimulations induce physiological alteration in blood pressure, heart rate, muscular tension, skin temperature and blood flow, pupil size, blink magnitude, electrodermal activity, and brain wave patterns immediately [13,18]. Furthermore, inhaled aromas activate endorphins, serotonin, and norepinephrine; the neurotransmitters that regulate the immune system, changing mood, and disrupting the anxiety and stress responses [13].

The potential of essential oils to reduce stress or anxiety is also associated with scents that remind of certain memories, especially pleasant ones [8]. In this context, certain mood and emotional states can be obtained through the application of essential oils that evoke relaxing, refreshing, or pleasant memories [3,13,18]. Finally, essential oils represent life energy extracted from plants with therapeutic properties that work synergistically and holistically to support human health [13,18].

## 4. Conclusion

This research concludes that inhalation of formulated essential oils provides a relaxing effect and reduce hypertension, significantly. The application of the aromatherapy formulation reduced systolic pressure by 8.5 mmHg and diastolic pressure by 1.2 mmHg. The combination of essential oils with the right composition and the presence of the same active compound components harmonizes the aroma with few contraindications, resulting in calming aroma and effect on the mind. Differences in gender response to scent confirmed women's superiority in odor detection and emotional valence. Inhalation

essential oils can be considered as an effective treatment intervention to reduce the stress and blood pressure in people with hypertension.

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