

**UTILIZATION OF EUCALYPTUS (*EUCALYPTUS
GLOBULUS*) AND PATCHOULI (*POGOSTEMON CABLIN*
BENTH) ESSENTIAL OILS IN AROMATHERAPY CANDLES
AS ALTERNATIVE THERAPY FOR MENTAL AND
RESPIRATORY HEALTH**

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ABSTRACT

The utilization of natural products as complementary therapy has increased significantly, particularly in the field of aromatherapy. Aromatherapy employs volatile plant-derived essential oils to promote relaxation, improve mood, and enhance physical and psychological well-being. Patchouli (*Pogostemon cablin* Benth) and eucalyptus (*Eucalyptus globulus* Labill.) leaves are important sources of essential oils with recognized calming and respiratory-supporting properties. This study aimed to formulate and evaluate aromatherapy candles containing a combination of patchouli and eucalyptus essential oils as an alternative complementary therapy for mental relaxation and respiratory comfort. An experimental design was employed using three formulation ratios of patchouli to eucalyptus essential oils, namely 1:2 (F1), 1:4 (F2), and 1:6 (F3). The prepared candles were evaluated for organoleptic characteristics, burning time, melting point, hedonic acceptance, and perceived therapeutic effects. Organoleptic evaluation demonstrated that all formulations produced white candles with smooth surfaces, free from cracks and fractures, while maintaining the characteristic aroma of patchouli and eucalyptus oils before and after burning. The burning time ranged from 139 to 170 minutes, and the melting point ranged from 51.9°C to 55.6°C, indicating acceptable physical stability. Hedonic testing revealed that Formula 3 (F3) achieved the highest level of participant preference. Furthermore, F3 received the most favorable

responses in the therapeutic assessment, with participants reporting greater feelings of relaxation and freshness after aromatherapy sessions. These findings indicate that patchouli and eucalyptus essential oils can be successfully formulated into stable aromatherapy candles. The formulation containing 1% patchouli essential oil and 6% eucalyptus essential oil demonstrated the best overall physical characteristics, user acceptability, and perceived therapeutic benefits, suggesting its potential as a complementary product to support mental well-being and respiratory health

Keywords: *aromatherapy candle; Pogostemon cablin; Eucalyptus globulus; essential oil; complementary therapy; mental health; respiratory health.*

INTRODUCTION

Mental health disorders and respiratory diseases remain major public health challenges worldwide, affecting millions of individuals and substantially reducing quality of life. Anxiety, psychological stress, sleep disturbances, and mild respiratory complaints have become increasingly prevalent due to urbanization, occupational pressure, environmental pollution, and post-pandemic lifestyle changes. Although pharmacological interventions are effective for many conditions, prolonged use may be associated with adverse effects, dependence, and high healthcare costs. Consequently, complementary and integrative therapies have gained increasing attention as safe and accessible approaches to improving physical and psychological well-being (World Health Organization [WHO], 2022).

Among various complementary therapies, aromatherapy has become one of the most widely practiced methods because it utilizes volatile compounds extracted from aromatic plants to produce therapeutic effects through inhalation. Essential oils stimulate the olfactory system, which directly communicates with the limbic system, an area of the brain responsible for regulating emotions, memory, stress responses, and autonomic nervous function (Herz, 2020). Several studies have demonstrated that inhalation of essential oils may reduce anxiety, improve sleep quality, decrease stress levels, and promote relaxation while simultaneously providing respiratory comfort through decongestant and antimicrobial activities (Koulivand et al., 2013; Gnatta et al., 2016).

Among numerous aromatic plants, eucalyptus (*Eucalyptus globulus* Labill.) is recognized as one of the most valuable medicinal plants because of its high essential oil content, particularly 1,8-cineole (eucalyptol). This compound possesses expectorant, mucolytic, anti-inflammatory, antimicrobial, and bronchodilatory properties, making eucalyptus oil beneficial for relieving nasal congestion, improving breathing comfort, and supporting respiratory

health (Juergens et al., 2020; Dhakad et al., 2018). In addition to respiratory benefits, inhalation of eucalyptus essential oil has been reported to reduce fatigue, increase alertness, and provide a refreshing sensation that may contribute to psychological well-being (Sadlon & Lamson, 2010).

Patchouli (*Pogostemon cablin* Benth.) is another economically important aromatic plant widely cultivated in Indonesia. Its essential oil is rich in patchouli alcohol, α -bulnesene, and α -guaiene, compounds responsible for its characteristic earthy aroma and pharmacological activities. Previous studies have demonstrated that patchouli essential oil exhibits anxiolytic, sedative, antioxidant, anti-inflammatory, and antimicrobial properties, making it a promising natural ingredient for stress reduction and emotional relaxation (Yang et al., 2022; Swamy et al., 2016). The warm and long-lasting fragrance of patchouli also acts as an excellent fixative, improving aroma persistence when blended with other essential oils.

Combining eucalyptus and patchouli essential oils may provide complementary therapeutic benefits because eucalyptus offers a fresh aroma associated with respiratory relief, whereas patchouli contributes calming and relaxing effects that enhance emotional balance. Such synergistic combinations have attracted increasing attention in aromatherapy product development. One practical dosage form is the aromatherapy candle, which gradually releases volatile compounds during combustion while simultaneously creating a soothing visual atmosphere. Compared with diffusers or direct inhalation, aromatherapy candles provide sustained fragrance release, ease of use, aesthetic value, and greater consumer acceptance in home and wellness environments (Ali et al., 2023).

The quality and therapeutic performance of aromatherapy candles depend not only on the selection of essential oils but also on their concentration and compatibility within the wax matrix. Physical characteristics such as appearance, melting point, burning time, fragrance stability, and consumer acceptability are important quality parameters that influence product performance and marketability. Furthermore, evaluating users' perceived therapeutic responses provides preliminary evidence regarding the practical effectiveness of aromatherapy products before clinical investigation.

Despite increasing commercial interest in aromatherapy candles, scientific studies evaluating formulations containing combinations of *Eucalyptus globulus* and *Pogostemon cablin* essential oils remain limited. Most published studies focus on individual essential oils or evaluate their biological activities separately, while investigations integrating both oils into candle formulations with assessments of physical quality, sensory acceptance, and perceived therapeutic effects are still scarce. Therefore, additional experimental

evidence is needed to support the development of standardized aromatherapy candle formulations based on these natural essential oils.

This study aimed to formulate aromatherapy candles containing combinations of eucalyptus (*Eucalyptus globulus* Labill.) and patchouli (*Pogostemon cablin* Benth.) essential oils at different concentration ratios and evaluate their physicochemical characteristics, burning performance, consumer preference, and perceived therapeutic effects. The findings are expected to contribute to the development of evidence-based natural aromatherapy products that may serve as complementary therapy to promote mental relaxation and respiratory comfort while supporting the sustainable utilization of Indonesia's medicinal plant resources.

METHODS

Study Design

This study employed an experimental laboratory design to formulate and evaluate aromatherapy candles containing combinations of eucalyptus (*Eucalyptus globulus* Labill.) and patchouli (*Pogostemon cablin* Benth.) essential oils. Three formulations with different concentrations of essential oils were prepared to determine the optimal formulation based on physicochemical properties, consumer acceptance, and perceived therapeutic effects.

Materials

The primary materials consisted of patchouli essential oil (*Pogostemon cablin* Benth.), eucalyptus essential oil (*Eucalyptus globulus* Labill.), soy wax, beeswax, cotton candle wicks, fragrance stabilizer (if required), and laboratory-grade analytical reagents. All essential oils were obtained from certified commercial suppliers and stored in tightly sealed amber glass bottles at room temperature before use.

Preparation of Aromatherapy Candles

Three formulations were prepared by varying the ratio of patchouli and eucalyptus essential oils while maintaining a constant wax composition. The formulations were as follows:

Formulation	Patchouli Essential Oil	Eucalyptus Essential Oil
F1	1%	2%
F2	1%	4%
F3	1%	6%

Soy wax and beeswax were melted using the double-boiler method at approximately 70°C until a homogeneous liquid was obtained. The molten wax was allowed to cool to approximately 55–60°C before the essential oils were added to minimize evaporation of volatile compounds. The mixture was stirred gently until homogeneous and then poured into candle containers equipped with centered cotton wicks. The candles were allowed to solidify at room temperature for 24 hours before evaluation.

Evaluation of Aromatherapy Candles

Organoleptic Evaluation

Each formulation was visually evaluated for color, surface appearance, homogeneity, presence of cracks, and aroma before and after combustion.

Burning Time

Burning time was determined by igniting each candle under controlled laboratory conditions until complete consumption. The burning duration was recorded in minutes using a digital stopwatch. Each formulation was tested in triplicate, and the average burning time was calculated.

Melting Point

The melting point of each formulation was measured using a melting point apparatus. The temperature at which the wax completely liquefied was recorded in degrees Celsius (°C). Measurements were performed three times for each formulation.

Hedonic Test

Consumer preference was evaluated using a hedonic test involving **30 healthy adult volunteers** aged 18–40 years. Participants assessed aroma, appearance, burning performance, and overall acceptability using a five-point hedonic scale ranging from 1 (strongly dislike) to 5 (strongly like).

Perceived Therapeutic Effect

The perceived therapeutic effects were assessed immediately after participants experienced the aromatherapy session in a quiet room for approximately 20 minutes. Participants completed a structured questionnaire evaluating subjective responses, including feelings of relaxation, freshness, breathing comfort, stress reduction, and overall satisfaction. Responses were rated using a five-point Likert scale ranging from strongly disagree to strongly agree.

Data Analysis

Experimental data were analyzed descriptively and presented as mean $\pm$ standard deviation. Organoleptic observations were summarized qualitatively, whereas burning time and melting point were expressed quantitatively. Hedonic and perceived therapeutic effect scores were analyzed using descriptive statistics to identify the

formulation with the highest level of participant acceptance and perceived therapeutic benefit. All analyses were performed using Microsoft Excel 2021.

RESULTS AND DISCUSSION

Three aromatherapy candle formulations containing combinations of patchouli (*Pogostemon cablin* Benth.) and eucalyptus (*Eucalyptus globulus* Labill.) essential oils were successfully prepared. The formulations differed only in the concentration of eucalyptus essential oil while maintaining a constant concentration (1%) of patchouli essential oil. All formulations exhibited good physical appearance, indicating that the essential oils were compatible with the wax base.

Table 1 summarizes the evaluation results of the prepared candles.

Table 1. Physical characteristics of aromatherapy candle formulations

Parameter	F1 (1:2)	F2 (1:4)	F3 (1:6)
Color	White	White	White
Surface appearance	Smooth	Smooth	Smooth
Cracks	None	None	None
Fractures	None	None	None
Burning time (min)	139	156	170
Melting point (°C)	51.9	53.8	55.6

Organoleptic evaluation demonstrated that all formulations produced white candles with smooth and homogeneous surfaces without visible cracks or fractures. These findings indicate that the addition of eucalyptus and patchouli essential oils did not adversely affect wax solidification or structural integrity. Moreover, the characteristic aroma of both essential oils remained detectable before and after combustion, suggesting adequate retention of volatile compounds within the candle matrix.

The melting point ranged from 51.9°C to 55.6°C, which falls within the acceptable range for aromatherapy candles intended for indoor use. A melting point above 50°C contributes to better dimensional stability during storage while still allowing gradual volatilization of essential oils during burning. Similar observations have been reported in previous studies, where soy wax and beeswax mixtures produced stable candle formulations with favorable thermal properties (Ali et al., 2023).

Burning time increased proportionally with the concentration of eucalyptus essential oil, ranging from 139 minutes in F1 to 170 minutes in F3. Longer burning duration is advantageous because it allows a more sustained release of volatile aromatic compounds, thereby extending the aromatherapy session. Burning performance is influenced by wax composition, wick diameter, and essential oil concentration. Previous investigations have also demonstrated that appropriate incorporation of essential oils does not necessarily shorten candle burning time when compatible wax formulations are employed (Lis-Balchin, 2016).

Hedonic Evaluation

Consumer acceptance is an important parameter in the development of aromatherapy products because fragrance preference directly influences product usability. The hedonic evaluation indicated that Formula 3 (F3) received the highest overall preference score among participants. Most respondents favored the fresh yet warm aroma produced by the combination of 1% patchouli and 6% eucalyptus essential oils. The increased preference for F3 may be attributed to the complementary fragrance characteristics of both essential oils. Eucalyptus contributes a fresh, clean, and cooling scent associated with respiratory freshness, whereas patchouli provides a warm, earthy aroma that enhances fragrance persistence. Patchouli essential oil is widely recognized as an excellent natural fixative, allowing more gradual evaporation of volatile compounds and improving fragrance longevity (Yang et al., 2022). Consequently, the balanced aroma profile produced by F3 was perceived as more pleasant than formulations containing lower concentrations of eucalyptus oil.

These findings are consistent with previous reports indicating that consumer preference for aromatherapy products is influenced not only by fragrance intensity but also by aroma balance and persistence (Swamy et al., 2016). A harmonious combination of essential oils may increase emotional comfort and improve overall user satisfaction.

Perceived Therapeutic Effects

Participants also evaluated the perceived therapeutic effects after approximately 20 minutes of candle exposure. Formula 3 produced the highest positive responses, particularly regarding relaxation, freshness, and breathing comfort. Many participants reported reduced mental tension and improved respiratory comfort after inhaling the aroma generated by the candle.

These observations may be explained by the pharmacological properties of the essential oils. Eucalyptus essential oil contains 1,8-cineole (eucalyptol), which exhibits mucolytic, bronchodilatory, antimicrobial, and anti-inflammatory activities that support respiratory function (Juergens et al., 2020; Dhakad et al., 2018). The refreshing sensation produced by eucalyptus oil may also enhance alertness while reducing feelings of fatigue.

Patchouli essential oil, on the other hand, contains patchouli alcohol and several sesquiterpenes known to possess anxiolytic and sedative effects. Inhalation of patchouli aroma has been associated with decreased stress levels, emotional relaxation, and improved mood through stimulation of the olfactory-limbic pathway (Herz, 2020; Yang et al., 2022). The combination of eucalyptus and patchouli therefore provides complementary physiological effects, simultaneously promoting respiratory comfort and psychological relaxation.

The present findings support the growing evidence that inhalation of essential oils may positively influence emotional well-being through interactions between olfactory receptors and the central nervous system. Volatile aromatic molecules rapidly activate the limbic system, which regulates emotion, memory, and autonomic responses, resulting in reduced sympathetic activity and enhanced parasympathetic responses associated with relaxation (Herz, 2020). Similar observations have been reported in clinical and experimental studies evaluating aromatherapy for stress reduction and anxiety management (Koulivand et al., 2013).

Although the present study demonstrated encouraging results, several limitations should be acknowledged. The therapeutic evaluation relied primarily on subjective participant responses without objective physiological measurements such as heart rate variability, oxygen saturation, cortisol concentration, or validated anxiety scales. In

addition, the sample size was relatively limited and the exposure period was short. Future studies should incorporate randomized controlled designs with larger participant populations and objective biomarkers to further validate the therapeutic potential of aromatherapy candles containing eucalyptus and patchouli essential oils.

Overall, Formula 3, containing 1% patchouli essential oil and 6% eucalyptus essential oil, demonstrated the best overall performance in terms of physical quality, burning characteristics, consumer acceptance, and perceived therapeutic benefits. These findings indicate that this formulation has promising potential as a natural aromatherapy product to support mental relaxation and respiratory comfort while promoting the utilization of plant-based essential oils in complementary healthcare.

CONCLUSION

This study demonstrated that the combination of patchouli (*Pogostemon cablin* Benth.) and eucalyptus (*Eucalyptus globulus* Labill.) essential oils can be successfully formulated into stable aromatherapy candles with satisfactory physicochemical properties. All formulations exhibited acceptable organoleptic characteristics, smooth surfaces, appropriate melting points, and favorable burning performance. Among the tested formulations, Formula 3, containing 1% patchouli essential oil and 6% eucalyptus essential oil, showed the best overall performance in terms of burning time, consumer preference, and perceived therapeutic effects. Participants reported greater feelings of relaxation, freshness, and respiratory comfort after exposure to this formulation. These findings suggest that aromatherapy candles containing patchouli and eucalyptus essential oils have promising potential as complementary products to support mental well-being and respiratory health. Further studies involving objective physiological measurements, larger sample sizes, and randomized controlled clinical trials are recommended to validate their therapeutic efficacy and expand their applications in evidence-based complementary healthcare.

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