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Formulation of the Balm Aromatherapy Combination Using the Essential Oils *Ocimum basilicum* L. and *Cymbopogon citratus* DC

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Abstract

This study aimed to analyze the formulation of an aromatherapy balm composed of the essential oils *O. basilicum* L. and *C. citratus* DC. Experimental research design involving the compilation of five balm formulations at concentrations of 0, 5, 10, 15, and 20%. For four months, balm formulations were made, and physical, chemical, and microbiological tests were carried out, which were further analyzed descriptively. The findings showed that the yield of essential oils obtained from distillation reached 0.19% w/v (*O. basilicum* L.) and 0.24% w/v (*C. citratus* DC). All formulations at concentrations of 0, 5, 10, 15, and 20% passed the organoleptic tests for topical dosage balms. This means that they were semisolid, smelled like essential oils, and were yellowish-brown based on the raw materials. The balm is completely homogeneous; there are no granules, and the color is evenly spread throughout the smear. The pH for the topical preparations ranged from 6–7, the dispersion power ranged from 5.02–6.10, and the adhesion ratio ranged from 2–6 depending on the concentration. Microbiological testing revealed that the aromatherapy balm was free of *S. aureus* and *P. aeruginosa* bacteria.

Keywords: aromatherapy balm, essential oil, basil, lemongrass, topical preparations

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1 Introduction

The balm is a healthcare product applied to diseased body parts and produces a therapeutic effect for its users [1,2]. Balm generally provides a sensation of heat and relief to alleviate pain or other flavors [3]. Currently, the use of balm in society has shifted quite significantly; in addition to being used for pain relief and muscle soreness, the use of balm has shifted to aromatherapy preparations used to relieve work-related stress and physical and emotional fatigue [4]. Aromatherapy balm has become a complementary therapy involving various bioactive compounds and essential oils of various plant components [5]. The rapid development of balm has led to the modification of various components to increase demand and improve therapeutic effects [6]. Balm aromatherapy is currently widely used by people, from teenagers to elderly people, because it provides a refreshing, calming effect and helps to overcome physical fatigue after use [7].

In Indonesia, balm is produced by mixing essential oils with resin oils obtained from plant parts and has a distinctive fragrance in a semisolid form [3]. Plants containing essential oils in Indonesia are classified as very abundant, reaching 97 types, and most of them come from tropical plants [8]. The plants that are widely used for aromatherapy with essential oils (EOs) are basil leaves (*O. basilicum* L.) and lemongrass (*C. citratus* DC.) [9–11]. These plants have various benefits, such as antioxidant, antibacterial, anti-inflammatory, and analgesic effects [12–14]. Research by Widodo, Arifin, Rina, and Zulkarnain [15] and Adnyana, Sudaryati and Sitepu [16] revealed that the citronella section contains bioactive compounds that are beneficial for health care. Citronella is useful as a kitchen spice and a raw material for medicines, insecticides, larvicides, and aromatherapy [17–19]. This is because lemongrass contains citronella, geraniol, mirsen, nerol, farnesol, and methyl heptagon [2]. According to Azizah [20], basil leaves contain essential oils such as α-citrate, β-citrate, trans-geraniol, α-linalool, estragole, eugenol methyl ether, and eugenol, which are used in aromatherapy.

Aromatherapy balms made from plant essential oils are currently very difficult to find. Apart from being a raw material that is difficult to obtain, aromatherapy balm products have not met the standards set following the Decree of the Minister of Health of the Republic of Indonesia No. 661/Menkes/SK/VII/94 that balm or other semisolid products should not have a rancid aroma [21]. This decreases people's interest in using it, and the product does not meet BPOM Regulation Number 32 of 2019 related to the safety and quality of traditional medicines, especially semisolid products. Therefore, adding essential oils is an alternative way to improve balm function, quality, and structure. The hope is that essential oils reduce rancid aromas and increase the therapeutic benefits obtained since essential oils have good pharmacological effects on the body when used at the right dosages [20,22,23].

In light of these issues, this research aims to identify and evaluate the physical requirements of balm quality with various formulations to develop the best formulation in the future. This study aimed to analyze the formulation of an aromatherapy balm composed of the essential oils *Ocimum basilicum* L. and *Cymbopogon citratus* DC. in terms of physical, chemical, and microbiological factors. This research provides information on developing an aromatherapy balm made from basil leaves and lemongrass for traditional medicine.

2 Methods

2.1 Research design

The experimental research design was a complete randomized design [24]. This study was conducted by compiling five formulations of an aromatherapy balm combination of basil leaf essential oil (*O. basilicum* L.) and lemongrass (*C. citratus* DC.) at different concentrations of 0% (code a), 5% (code b), 10% (code c), 15% (code d), and 20% (code e). This study performed organoleptic testing, homogeneity, acidity (pH), adhesion, absorption, and microbiological contamination tests on *S. aureus* and *P. aeruginosa* bacteria.

2.2 Instruments and materials

The instruments used in this study included steam distillation devices, analytical balances, UV–Vis spectrophotometers, pH meters, filter paper, measuring flasks, stopwatches, Petri dishes, dispersal test equipment, adhesion containers, and balm containers. In this study, the materials used included the leaves of *O. basilicum* L. and *C. citratus* DC obtained from farmers directly located at Banjar Tangtu Kesiman, Kertalangu, and East Denpasar. In addition, agar nutrients (NA), ethanol pro-analysis (PA), ethyl acetate pro-analysis (PA), chloroform pro-analysis (PA), aquades, Vaseline album, menthol, oleum methane, Cera alba, paraffin liquid, virgin coconut oil (VCO), cocoa butter, and beeswax are the additional ingredients used. Test bacteria (*S. aureus* and *P. aeruginosa*) were obtained from the Microbiology Laboratory of the Faculty of Medicine, Udayana University.

2.3 Plant determination

Leaf *O. basilicum* L. and the stems and leaves of *C. citratus* DC were identified and identified in the Bali Plant Conservation Eka Karya Bali Botanical Garden of the UPT, which is in the Jalan Botanical Garden, Candikuning, Kecamatan Baturiti, Tabanan Regency, Bali.

2.4 Creation of a balm combination

At this stage, the ingredients were prepared, namely, *O. basilicum* L. and as much as 6,200 g, which were then washed thoroughly with running water, cut into 3–4 cm pieces, and then dredged for two days. The final weight of the dried basil leaves is 5.450 g. Furthermore, distillation for 3-5 hours is performed to produce the distillate, and the distillate that has been added to the Erlenmeyer flask is then treated with 25 g of NaCl to reduce the water content. Yield quality measurements were performed at the end, and 10.5 mL of *O. basilicum* L. essential oil was added at the end of the process. The components of these formulations are listed in Table 1.

Tabel 1. Aromatherapy balm formulations with different concentrations . [7]

Material	unit	Formulation				
		A	B	C	D	E
EO *O. basilicum* L.	Ml	0	1	2	3	4
EO *C. citratus* DC.	Ml	0	1	2	3	4
VCO	g	8	8	8	8	8
Vaseline albums	g	20	20	20	20	20
Cera Alba	g	6	6	6	6	6
Cocoa Butter	g	8	8	8	8	8
Menthol	g	6	6	6	6	6

The stems and leaves of *C. citratus* DC, up to 6,500 g, were thoroughly removed by washing. The meat was then cut to 3 cm and air-dried for two days, yielding a dry weight gain of 4.980 g. The next stage, steam distillation, is carried out by inserting 3 L of water with a distillation process lasting 4 hours to produce 620 mL of distillate with the acquisition of essential oil from *C. citratus* DC. (11.8 mL). The aromatherapy balm was prepared by combining five formulations, with concentrations ranging from 0% (0 mL) to 5% (2 mL), 10% (4 mL), 15% (6 mL), and 20% (8 mL). An aromatherapy balm is made by weighing the balm base material and melting all types of ingredients in a water bath. After the entire mixture was melted, a mixture of *O. basilicum* L. and *C. citratus* DC. was added according to the predetermined concentration, and the mixture was stirred until homogeneous and cooled. The cooled balm was then placed in a container that had been provided.

2.5 Physical, chemical, and microbiological testing

2.5.1 Organoleptic test

This was done by observing the preparation of the balm in terms of shape, aroma, and color. The balm should have a

semisolid shape and color according to its composition, not a rancid aroma.

2.5.2 Homogeneity Test

A total of 1 g of balm was applied to the glass object; then, homogeneity observation was carried out, characterized by no lumps, even structure, and uniform color at all smear points.

2.5.3 pH (power of hydrogen) test

The acidity of the aromatherapy balms was examined using a stick pH meter with the electrode selective ion method and repeated three times for each formulation.

2.5.4 Adhesion test

Adhesion testing was carried out by placing 0.1 g of aromatherapy balm on a glass object. It was then covered with a glass object and pressed for 5 min with a load of 1 kg. After 5 min, the load was lowered, and the lever was pulled with load variations of 50 g, 100 g, 150 g, and 200 g, which was further calculated as the time required until the two glass objects separated.

2.5.5 Spread power test

Dispersion testing was carried out by taking an aromatherapy balm (0.5 g) and placing it on the center of the square glass. The samples were covered with glass and then weighed and left for 1 min each at different loads of 50, 100, 150, and 200 g. The diameter distributions were recorded and are presented as graphs between the loads.

2.5.6 Contamination test

Microbiological contamination tests were performed using the agar plate diffusion method on a solid medium surface. After sterilizing the tool in an autoclave for 20 min at 121°C and 1 atm pressure, the tool that did not tolerate heat was sterilized using 96% ethanol. In the second stage, sodium agar (NA) media was prepared by dissolving 38 g of NA in 1 L of aquades. Furthermore, the heating process was carried out until the solution dissolved, and the solution was then placed in a Petri dish with a volume of 10 mL. Sodium agar was then sterilized in an autoclave for 15 minutes at a pressure of 1 atm at a temperature of 121°C. The mixture was then removed and cooled to 35 °C before being poured into a petri dish for thickening. Third, sample inoculation was carried out by using a spread plate method on one oyster, which was then incubated in an incubator at 37 °C for 48 hours. Subsequently, the type and nature of the test bacteria were identified.

2.6 Data Analysis

The data in this study were analyzed descriptively and are presented in the form of tables of measurement results, images/documentation, and narratives [25].

3 Results and Discussion

3.1 Essential oil distillates of O. basilicum L. and C. citratus DC.

In this study, the amount of essential oil added to *O. basilicum* L. was as much as 10.5 mL, whereas the amount of essential oil added to *C. citratus* DC. was as high as 11.8 mL. Table 2 presents the *rendeman* results. The essential oil obtained from basil was brownish, and that obtained from lemongrass was yellowish. Furthermore, both yield types have distinctive aromas, namely, lemongrass and basil, with final yields of 0.19 w/v (*O. basilicum* L.) and 0.24 w/v (*C. citratus* DC), respectively. The results of the steam distillation are presented in Figure 1. Based on these results, the ratio of the two essential oils tended to be small. In this case, a good simplification for distillation had a maximum moisture content of 10% of the raw material. This finding follows what Armando (2009) stated: "The resulting amendments are thought to be due to distillation factors, the volume of raw material density, and the growing environment of plants."

Table 2. The yield of essential oils from *O. basilicum* L. and *C. citratus* DC

Plant	Essential Oil results		
	Color	aroma	Amendment (% w/v)
Basil (*O. basilicum* L.)	Brownish	Bitter, Typical Basil Leaves	0,19
Lemongrass (*C. citratus* DC)	Yellowish	Bitter, Typical lemongrass	0,24

Figure 1 The results of the distillation of essential oils from *O. basilicum* L. (left) and *C. citratus* DC (right).

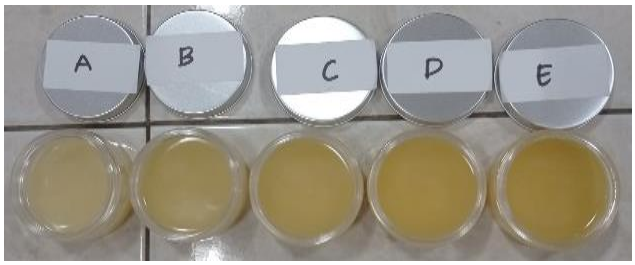

Figure 2 Balm aromatherapy combinations of *O. basilicum* L. and *C. citratus* DC essential oils at different concentrations. Notability: (a) Balm without essential oils, (b) with 5% essential oil (2 mL), (c) with 10% (4 mL) essential oil, (d) with 15% essential oil (6 mL), and (e) with 20% essential oil (8 mL).

3.2 O. basilicum L. and C. citratus DC. Combination of Essential Oil Balm Aromatherapy

Balm is a semisolid preparation used topically on affected or sore skin [1,3]. Balm in BPOM Regulation number 32 of 2019 is classified as an external medicine similar to an ointment, but the difference is that it contains oil and aroma. An aromatherapy balm containing the essential oils *O. basilicum* L. and *C. citratus* DC was created in this study by combining common balm ingredients (bases), such as virgin coconut oil, Vaseline album, Cera alba, cocoa butter, and menthol. The balm contained Vaseline albumin as an emollient ingredient, Cera alba as a compactor, and menthol to provide a cooling sensation. Menthol is a natural component produced from Mentha piperita L. and is widely used as a cosmetic additive or topical preparation [26–28]. Warditiani [4] showed that the color of each balm formulation was relatively different. In formulation A, where the addition of essential oils is not carried out, it produces a paler color than does the addition of essential oils in formulations B, C, D, and E. Balsam aromatherapy is achieved by combining the essential oils of *Ocimum basilicum* L. and *Citratus citratus* DC. The different formulations are shown in Figure 2.

3.3 Testing of physical, chemical and microbiological properties

3.3.1 Organoleptic test results

At this stage, the texture, aroma, and color of each balm formulation made from the combination of the essential oils of *O. basilicum* L. and *C. citratus* DC at the different concentrations presented in Table 3 were observed. The results of the visual observations show that the texture of the entire balm formulation is semisolid. Upon color examination, the essential oil was added, and the balm preparation was yellower. This indicates that the color corresponds to that of the essential oil produced during distillation. Furthermore, when the aroma was examined, the greater the concentration of essential oils added to the balm mixture was, the stronger, but not rancid, the aroma produced. We found that if many concentrated essential oils are added, the aroma becomes clearer and more intense. However, the two essential oils added in the same amount were still dominated by the aroma of the essential oils compared to the distinctive aroma of the basic essential oils. These results align with those of Höfer [14], Ghavam [6], and Valková [29], who stated that the higher the concentration of essential oil added to a product is, the stronger the aroma produced.

Table 3 Test results for the combinations of organoleptic preparations

Formulation	Texture	Color	Aroma
A (0%)	Semisolids	Pale yellow	Typical menthol
B (5%)	Semisolids	Light yellow	Typical essential lemongrass and thin basil
C (10%)	Semisolids	Light yellow	Typical essential lemongrass and basil are quite obvious
D (15%)	Semisolids	Light yellow	Typical essential lemongrass and basil are obvious
E (20%)	Semisolids	Dark yellow	Typical essential lemongrass and basil are very clear.

Table 4 Homogeneity, pH, dispersion, and adhesion test results

Formulation	Homogeneity	pH	Dispersion power (cm)				Adhesion (second)
			Load 50 g	Load 100 g	Load 150 g	Load 200 g	
A (0%)	+	6,9	5,20	5,23	5,30	5,33	6 Sec
B (5%)	+	6,8	5,10	5,02	5,40	5,50	5 Sec
C (10%)	+	6,5	5,20	5,50	5,56	5,60	4 Sec
D (15%)	+	6,3	5,40	5,46	5,53	5,67	3 Sec
E (20%)	+	6,2	5,63	5,90	6,06	6,10	2 Sec

3.3.2 Homogeneity, pH, dispersion, and adhesion test results

At this stage, an examination of homogeneity was carried out by examining the evenness of the structure, uniformity of color, and presence of coarse grains. pH testing was performed by dipping a pH meter stick into essential oil to determine the pH of each formulation. Furthermore, the dispersion power test was carried out by applying a different load to the test balm preparation, which was then measured for diameter. Finally, the adhesion test is carried out by separating the glass object that contains the balm, whose separation time between the glass objects is measured. The test results for homogeneity, pH, dispersion, and adhesion are presented in Table 4.

The homogeneity of the balance of the essential oils of *O. basilicum* L. and *C. citratus* DC at different concentrations (Table 4) was stimulated by applying as much as 1 g of balm to the glass. The findings showed that from formulations A to E, there were formulations that were entirely flat in structure, had a uniform color from the starting point of smearing to the endpoint, and had no coarse grains. Thus, the entire formulation was considered homogeneous (+). A high-quality balm should be free of coarses or lumpy particles. The Directorate General of Food and Drug Administration states that the preparation is considered homogeneous if all smears on transparent glass have a flat structure and the same color and do not coagulate or emit coarse grains. Our findings indicate that the combinations of *O. basilicum* L. and *C. citratus* DC essential oils at different concentrations have uniform homogeneity. In line with Stanciauskaite [12] and Heckford [30], the homogeneous formula of the balm indicated that the bioactive compounds were evenly distributed. In addition, stirring is carried out constantly to make the balm, resulting in the mass of the balm not containing particles or coarse grains.

Upon examination of the pH of the balm, it is expected that the acidity of the preparation must correspond to the pH of the topical preparation. In this case, the results of testing the acidity of the combined balm solutions at different concentrations were obtained on average at pH 6-7, with three repetitions each. This indicated that all formulations met the skin pH standards. A pH below 5 indicates that the balms are acidic and can irritate the skin. Moreover, if the pH of the balm is greater than 7, the balm is alkaline, which can cause dry and scaly skin [4,7,31]. When the concentration of the essential oils increases, the pH decreases. This indicated that the essential oils of *O. basilicum* L. and *C. citratus* DC. are acidic. These findings are consistent with those of Mulagi, Anton, and Mutlu-Ingok, who discovered that essential oils are mostly acidic.

On the distribution line, a power check was conducted to determine the ease of application when the balm was used. Our findings on the dispersal power of the combination of *O. basilicum* L. and *C. citratus* DC at various loads revealed that the greater the weight of the load exerted on the balm was, the greater the

increase in dispersion. As a result, all formulations A–E met the dispersion test requirements for topical preparations such as balm. This is in line with the research of Rachmalia [32], who stated that the dispersion requirements for topical preparations ranged from 5-7 cm. In addition, the dispersion test showed that the greater the concentration of essential oils added was, the wider the spread of the balm. Good dispersion results in wider contact between the drug and the skin, so that absorption of the drug into the skin occurs quickly. Ojha [33], Wang [9], and Indrayani [3], who reported good spreadability, indicated that the contact between the topical preparation and the skin became wider, so that the active substance was absorbed faster. Lunz [34], Deore [35] and Bhadra [5] dispersal power is used to identify balsam laxity associated with ease of smearing on the skin.

In the adhesion test, the time required for the two glass objects to adhere to each formulation varied. As a result, the greater the concentration of essential oils added to each formulation was, the lower the adhesion. In this study, we found that the adhesion decreased (but did not meet the criteria) in formulations D and E, whereas the adhesion in formulations A, B, and C met the criteria. This refers to the research of Rachmalia [32], which states that the requirement for good adhesion quality must be more than 4 s. According to our findings, the more essential oils used, the thinner the balm becomes, and the adhesion ability decreases. Good adhesion allows the balm to not come off easily and to stick to the skin longer to produce the desired effect. The longer the adhesion of the balm is, the better because the active substance will be well absorbed on the entire surface of the skin [1, 36–38].

3.3.3 Microbiological test results

Microbiological contamination testing of topical drug preparations is expected to lower the risk of bacterial exposure after drug use. Contamination tests are used to ensure that the product is free from pathogens that can irritate and damage the skin tissue [2,36,38,39]. In this study, we used two types of test bacteria, *S. aureus* and *P. aeruginosa*, the results of which are presented in Table 5.

Table 5 Microbiological contamination testing of aromatherapy balms

Formulation	Test bacteria		Reference
	S. aureus	*P. aureginosa*	
A (0%)	Negative	Negative	Unpolluted
B (5%)	Negative	Negative	Unpolluted
C (10%)	Negative	Negative	Unpolluted
D (15%)	Negative	Negative	Unpolluted
E (20%)	Negative	Negative	Unpolluted

Table 5 shows the combination of aromatherapy balm of *O. basilicum* L. and *C. citratus* DC. The bacteria tested negative for essential oils because there was no bacterial growth on sodium agar (NA) media. According to these findings, aromatherapy balms with different formulations conformed to topical drug standards and were free of gram-positive (*S. aureus*) and gram-negative (*P. aeruginosa*) bacteria. Processing balm products following traditional topical drug manufacturing requirements results in no contamination or microbial growth activity [1,12,13]. Azizah [20] and Guntur [40] reported that the essential oil of *O. basilicum* L. contains eugenol, which is an effective antibacterial agent because it can prevent the growth of bacteria, viruses, and fungi, and its flavonoid content is an antioxidant. α-Citral (25.62%), β-citral (19.25%), trans-geraniol (14.36%), α-linalool (13.26%), estragole (86.4%), eugenol methyl ether (0.5%), and α-elemene (0.3%) are essential components of basil leaf essential oils that have good antimicrobial activity [22,40]. Essential oil from *C. citratus* DC. also contains bacteria-inhibiting compounds such as citronella, geraniol, mirsen, nerol, farnocell, and methyl heptenone [41]. This is because compounds containing phenols and flavonoids are widely developed as antibacterial and antimicrobial agents for manufacturing cosmetics and medicines [42].

4 Conclusions

The demand for balm aromatherapy has increased in various social circles. This necessitates the development of product formulations derived from natural substances, particularly essential oils. Our findings pertain to the formulation of *O. basilicum* L. and *C. citratus* DC aromatherapy balm combinations. At different concentrations (0, 5, 10, 15, and 20%), the topical preparations met the quality

standards of topical products in terms of organoleptic testing, namely, semisolid shape, characteristic aroma of essential oils, and yellowish-brown color according to the raw materials. The balm was entirely homogeneous; no granules were found, and the color of the smear was evenly distributed. The pH for the topical preparations ranged from 6–7, the dispersion power ranged from 5.02–6.10, and the adhesion ratio ranged from 2–6 depending on the concentration. Microbiological testing revealed that the aromatherapy balm essential oils of *O. basilicum* L. and *C. citratus* DC were free of *S. aureus* and *P. aeruginosa* bacteria. In the future, it will be necessary to test the effectiveness and efficacy of balm, whether as a therapeutic agent for aromatherapy or to treat other diseases.

5 Declarations

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5.2 Author Contributions

P.L.C: Conceptual, methodology, supervisor; I.B.P.S: product manufacturing, research permits, funding coordinator; I.P.S: data curation, data analysis, manuscript draft writing; I.A.A.D.S: product manufacturing, testing, and analysis; P.N.S.D: product manufacturing, testing, and analysis. All authors have approved the final manuscript.

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5.4 Conflicts of Interest

The authors declare no conflict of interest.

5.5 Ethic

Not applicable because the research does not include animals and/or humans as subjects.

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