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Formulation and Evaluation of Balm Stick Preparations from the Essential Oil of *Eucalyptus resinifera* Leaves

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ABSTRACT

Balm is one of the pharmaceutical products with an ointment base that uses essential oils as one of the ingredients in its formulation. One of the essential oils found in Indonesia is *Eucalyptus resinifera* essential oil. In Indonesia, the use of *E. resinifera* leaf essential oil in balm stick formulations has not yet been reported. The purpose of this study was to formulate and characterize a balm stick preparation from *E. resinifera* leaf essential oil for the development of health products. The methods used included the formulation of *E. resinifera* essential oil balm with four essential oil concentrations (0%, 15%, 20%, and 25%) and evaluation of the preparations through homogeneity, spreadability, adhesion, pH, and skin irritation tests. The results showed that the best formula was Formula III, containing 20% essential oil, which met the requirements for a good balm preparation based on the results of the homogeneity test (homogeneous), spreadability test (3.9 cm), adhesion test (>1 minute), pH test (4.6), and skin irritation test (no irritation observed), and was also the most preferred according to the organoleptic test.

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INTRODUCTION

Eucalyptus is a type of tree native to Australia. There are more than 700 species of eucalyptus , most of which are native to Australia [1], while some can also be found in Papua New Guinea and Indonesia [2]. *Eucalyptus* is a fast growing plant species and one of the types cultivated for the development of industrial plantation forests [3]. It is also one of the important essential oil producing trees for Indonesia's essential oil industry, with the oil obtained through the distillation of *Eucalyptus* leaves [4]. The essential oil from *Eucalyptus* leaves provides an aromatherapy effect with a distinctive fragrance, helping to calm the mind and create a refreshing sensation for anyone who inhales it [5].

One of the *Eucalyptus* species found in Indonesia and abundantly growing in the forest area of Pattapang Village, Tinggimoncong District, Gowa Regency, South Sulawesi, is *Eucalyptus resinifera*. The leaves of *E. resinifera* in this area are considered waste and are not utilized by the local community. This is due to the fact that the species is not widely known; however, it has

potential as a source of essential oil and could be developed into various health products, such as balsam [6].

Balsam is a type of pharmaceutical product in ointment form [7]. Essential oil is one of the ingredients used in balsam preparation [8]. The balsam stick dosage form is an innovation that can be applied directly without dirtying the hands during use, in addition to being more practical and portable [9–10].

The use of *Eucalyptus* oil in balm stick formulations has previously been conducted by Wulandari, 2024 [11], utilizing the *Eucalyptus globulus* species. However, the essential oil extracted from *E. resinifera* leaves grown in Indonesia has not yet been reported for use in balm stick formulations. Therefore, this study is considered necessary to determine the success rate of balm formulation using *E. resinifera* essential oil. This study aims to formulate and characterize a balm stick preparation from *E. resinifera* leaf essential oil and to provide information regarding its potential utilization in the development of health products.

MATERIALS AND METHODS

This study employed a laboratory experimental approach to formulate and characterize a balm stick preparation from *E. resinifera* leaf essential oil. The research was conducted at the Chemistry Laboratory of Muhammadiyah University of Bulukumba from April to July 2024.

Tools and Materials

The equipment used in this study included an analytical balance (Osuka), a pH meter (ATC), a hot plate (Maspion), balsam stick containers, a mortar, a pestle, and other glassware. The materials used in this study were *E. resinifera* leaf essential oil, *cera alba* (beeswax), menthol, anhydrous sodium sulfate, *oleum menthae* (peppermint oil), liquid paraffin, white petrolatum, and distilled water.

Research Procedure

Preparation of balsam stick

Table 1. Formula of *E. resinifera* Leaf Essential Oil Balsam

Ingredients	F1	F2	F3	F4
E. resinifera Leaf Essential Oil	0%	15%	20%	25%
Paraffin	4 g	4 g	4 g	4 g
Menthol	3 g	3 g	3 g	3 g
Oleum Menthae (Peppermint Oil)	3 g	3 g	3 g	3 g
White Petrolatum (*Vaselin Album*)	10 g	10 g	10 g	10 g
Cera Alba (Beeswax)	10 g	10 g	10 g	10 g

Notes:

- F1 = Balsam stick without *E. resinifera* leaf essential oil
- F2 = Balsam stick with 15% *E. resinifera* leaf essential oil
- F3 = Balsam stick with 20% *E. resinifera* leaf essential oil
- F4 = Balsam stick with 25% *E. resinifera* leaf essential oil

All ingredients, including liquid paraffin, white petrolatum, menthol, and *cera alba*, were weighed and melted on a hot plate. After all the ingredients were completely melted, *E. resinifera* leaf essential oil was added at concentrations of 0%, 15%, 20%, and 25%, then stirred until homogeneous. The mixture was allowed to cool and then poured into balsam stick containers.

Preparation evaluation testing

Homogeneity test

The homogeneity test of the balsam stick preparation was carried out by applying the balsam stick onto the surface of an object glass or another transparent material. Good homogeneity is indicated by the absence of lumps in the application result, a smooth texture, and a uniform color from the starting point to the end point of application [9].

Spreadability test

A total of 0.5 g of balsam was weighed and placed in the center of an inverted watch glass. A 100 g weight was then placed on top of the watch glass and left for 1 minute. The changes were observed, and the diameter was measured. A good balsam preparation for a typical semistiff consistency has a spread diameter of 3–5 cm [12].

Adhesion test

A total of 0.5 g of balsam was weighed and placed on a watch glass, which was then inverted and left for 1 minute [12].

pH test

A test solution was prepared by dissolving 0.5 g of the sample to a final volume of 5 mL, and the pH of the solution was measured using a pH meter. The appropriate pH range according to the Indonesian National Standard (SNI 16–4399–1996) is 4.5–8 [13].

Skin irritation test

The test was carried out by applying the balsam stick preparation to the skin of the forearm. A positive irritation reaction is indicated by the presence of redness, itching, or swelling on the skin [14].

Organoleptic test

The organoleptic test was conducted using 30 untrained panelists to evaluate the balsam stick preparation in terms of its color, aroma, and texture.

RESULTS AND DISCUSSION

Evaluation Results of *E. resinifera* Leaf Essential Oil Balsam

Table 2. Evaluation Results of Balsam Stick Preparation

Test	Formula I	Formula II	Formula III	Formula IV
Homogeneity Test	Homogeneous	Homogeneous	Homogeneous	Homogeneous
Spreadability Test	4 cm	4 cm	3.9 cm	4.1 cm
Adhesion Test	> 1 minute	> 1 minute	> 1 minute	> 1 minute
pH Test	6.5	4.9	4.6	3.8
Skin Irritation Test	No irritation occurred	No irritation occurred	No irritation occurred	Itching sensation on the skin

The homogeneity test results of each balsam stick formulation showed a uniform appearance without any coarse particles on the glass slide, indicating that all ingredients were perfectly mixed within the base formulation. This homogeneous condition suggests that the mixing process and melting temperature used in the formulation were optimal for distributing both the active ingredients and excipients. Good homogeneity is crucial as it directly affects the consistency of the active ingredient dosage in every part of the preparation, ultimately determining the physical stability and therapeutic effectiveness of the balsam. These findings are consistent with the statement of Anastasia and Romadhonni (2019) [15], who noted that a balsam preparation is considered homogeneous when no coarse particles are observed on the glass slide. Moreover, the uniform distribution of active ingredients such as essential oils ensures an even spread of the active compounds when applied to the skin, thereby providing consistent and maximum therapeutic effects [16].

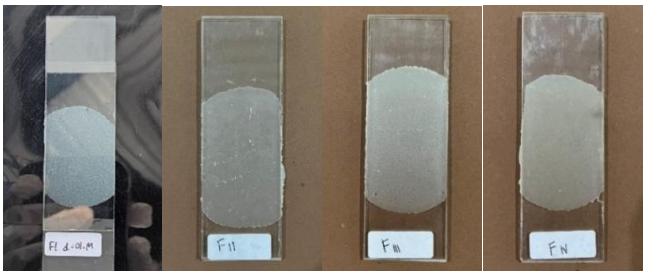

Figure 1. Homogeneity Test Results

The spreadability test results showed that all formulas FI (4 cm), FII (4 cm), FIII (3.9 cm), and FIV (4.1 cm) fell within the standard range for good balsam spreadability, which is 3–5 cm [12]. The relatively uniform spreadability values among the formulas indicate that variations in the concentration of *E. resinifera* leaf essential oil did not significantly affect the spreading ability of the preparation. This suggests that the base composition (a mixture of paraffin, menthol, *oleum menthae*, white petrolatum, beeswax, and essential oil) was able to maintain consistent viscosity across formulations. Optimal spreadability reflects a balance between the thickness and smoothness of the preparation, allowing the balsam to be easily applied without leaving excessive stickiness. This also supports the uniform absorption of active substances on the skin surface, potentially enhancing both user comfort and the therapeutic effectiveness of the product.

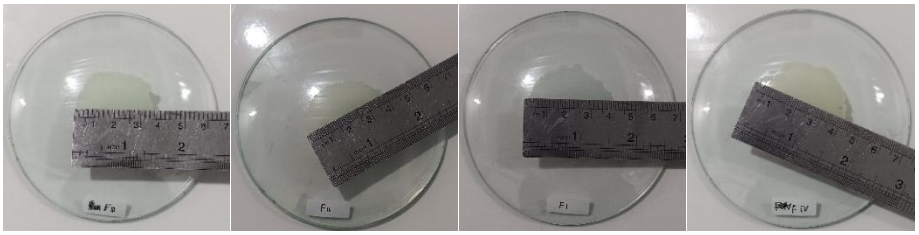

Figure 2. Spreadability Test Results

The adhesion test results for each balsam stick formulation showed that all preparations were able to adhere for more than one minute, indicating that they met the requirement for good adhesion, which is more than 4 seconds [17]. The high adhesion values suggest that the formulations possess strong adhesive ability to the skin surface, allowing the active ingredients in the balsam to have a longer contact time for absorption. This good adhesive property may be influenced by the composition of the base and additional ingredients used, such as the proportions of wax, paraffin, or petrolatum, which play roles in regulating the consistency and cohesion of the preparation. The volatile nature of *E. resinifera* leaf essential oil may also affect the interaction between the base materials and the skin. With adhesion lasting more than one minute, it can be concluded that the formulations have an appropriate balance of viscosity and plasticity for topical use, as they do not easily detach from the skin surface while remaining comfortable during application.

Figure 3. Adhesion Test Results

The pH test results showed that formulations FI (6.5), FII (4.9), and FIII (4.6) were within the normal skin pH range of 4.5–6.5 [9], while FIV (3.8) had a pH below this range and therefore did not meet the requirement. The appropriate pH values indicate that these formulations are safe for topical use, as they will not disrupt the skin's natural acid balance. The differences in pH values among the formulations may be attributed to the varying concentrations of *E. resinifera* leaf essential oil used [11]. Essential oils generally contain phenolic and terpenoid compounds that are slightly acidic, so increasing the concentration of the oil can lower the pH of the preparation. This explains why FIV, which contains the highest concentration of essential oil, exhibited the lowest pH value (3.8).

Figure 4. pH Test Results

A pH level that is too low has the potential to cause skin irritation [18], while a pH that is too high can damage the skin's protective barrier. Therefore, formulations FI–FIII can be categorized as stable and safe for use, whereas FIV requires compositional adjustments, such as adding a neutralizing agent or reducing the proportion of acidic components. These results highlight the importance of pH control in balsam formulation to ensure optimal therapeutic effectiveness without causing local side effects [19].

The skin irritation test results showed that Formulas I, II, and III did not cause any irritation reactions on the skin, whereas Formula IV caused mild irritation in the form of itching. This indicates that the first three formulations have good compatibility with the skin, while Formula IV requires re-evaluation of both its active ingredients and base composition. The occurrence of skin irritation from the use of Formula IV balsam is likely related to its lower pH value (3.8), as observed in the previous pH test results. A pH that is too acidic can disrupt the skin's natural acid balance and stimulate pain receptors, resulting in sensations of itching or stinging. Additionally, the higher concentration of *E. resinifera* leaf essential oil in Formula IV may increase the risk of irritation due to its content of volatile and phenolic compounds (such as eucalyptol), which can be strong or harsh on skin tissues.

Figure 5. Skin Irritation Test Results

According to Romadhoni et al. (2022) [20], irritation testing aims to ensure the safety of topical preparations so that they do not cause side effects such as burning sensations, dryness, redness, or itching. Thus, these results reinforce the importance of adjusting the concentration of essential oil to maintain its effectiveness as an active ingredient while remaining within safe limits for the skin. The formulations that did not cause irritation (FI–FIII) are therefore suitable for further evaluation through organoleptic testing involving 30 panelists to assess user acceptance aspects such as aroma, texture, and comfort during application. This step is important to ensure that the final product is not only dermatologically safe but also possesses sensory characteristics that are appealing to users.

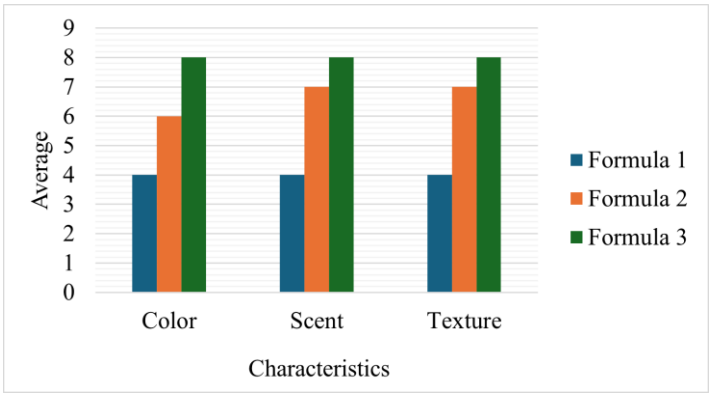

Figure 6. Organoleptic Test Results

The sensory organoleptic (hedonic) test aims to assess the quality differences among similar products and to measure consumer preference levels for certain characteristics of a product [21].

The organoleptic test results shown in Figure 1 indicate that Formulas I, II, and III differed in the level of panelist preference across three main indicators: color, aroma, and texture. Formula I received the lowest scores in all parameters because it did not contain *E. resinifera* essential oil. The absence of the essential oil resulted in the preparation lacking a distinctive aroma and appealing color appearance, making it perceived as less innovative by the panelists. In addition, the texture of Formula I tended to be denser and less smooth, possibly due to the high proportion of solid base ingredients such as paraffin or wax without the presence of oil components that function to soften the balsam matrix.

Formula II showed an increased level of preference, particularly in terms of color and aroma. The addition of 15% essential oil provided a distinctive, refreshing scent and enhanced visual appeal through the natural color change imparted by the essential oil. The texture of Formula II was also rated smoother, as the essential oil acts as a plasticizer that reduces the rigidity of the preparation's structure.

Meanwhile, Formula III received the highest scores across all three organoleptic aspects. The 20% essential oil concentration provided an optimal balance between aroma, color, and texture smoothness. The increased essential oil content not only enriched the aromatherapeutic sensation but also improved the physical characteristics of the preparation by reducing viscosity and enhancing its spreadability on the skin. This indicates that *E. resinifera* essential oil functions not only as an active ingredient but also makes a significant sensory contribution to user acceptance.

CONCLUSION

Based on the research results, it can be concluded that the best formula is Formula III, containing 20% *Eucalyptus resinifera* leaf essential oil, as it meets all the criteria of a good balsam preparation in terms of homogeneity, spreadability, adhesion, pH, and skin safety, and is also the most preferred in the organoleptic test. Scientifically, these results indicate that *E. resinifera* essential oil has potential as a natural active ingredient that not only provides therapeutic effects but also enhances the physical and sensory quality of the formulation. This finding can serve as a foundation for developing natural based balsam products that are effective, safe, and have high added value.

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REFERENCES

[1] D. S. R. Koresy dan A. Jayuska, "Isolasi dan Aktivitas Antibakteri Minyak Atsiri Daun Gugur Eucalyptus staigeriana," *J. Kim. Khatulistiwa*, vol. 8, no. 1, hal. 91–95, 2019.

[2] F. Mangkuwibowo, S. Indrioko, dan A. Nirsatmanto, "INTERAKSI FAMILI × LOKASI PADA UJI KETURUNAN GENERASI KEDUA Eucalyptus pellita Family × site interaction observed in second-generation progeny trial of Eucalyptus pellita Oleh karena adanya serangan hama dan penyakit yang serius pada Acacia mangium sebaga," *J. Pemuliaan Tanam. Hutan*, vol. 12, no. 1, hal. 25–39, 2018.

[3] E. D. Sulichantini, "Pertumbuhan Tanaman Eucalyptus pellita F. Muell di Lapangan dengan Metode Kultur Jaringan, Stek Pucuk, dan Biji," *J. Ziraa'ah*, vol. 41, no. 2, hal. 269–274, 2016, doi: 10.1017/CBO9781107415324.004.

[4] Irvan, M. Putra, dan S. Januar, "Ekstraksi 1,8-Cineole Dari Minyak Daun Eucalyptus Urophylla Dengan Metode Soxhletasi," *J. Tek. Kim. USU*, vol. 4, no. 3, hal. 52–57, 2015, doi: 10.32734/jtk.v4i3.1482.

[5] A. N. . Abubakar, M. . Pratama, S. Husna, dan E. Jumrah, "Pengolahan Daun Eucalyptus Menjadi Produk Herbal Sebagai Upaya Peningkatan Ekonomi Kelompok Tani Hutan Buluballea," *J. Panrita Abdi*, vol. 7, no. 1, hal. 38–46, 2023.

[6] K. Butar-Butar, G. I. Dalimunthe, M. S. Lubis, dan R. Yuniarti, "FORMULASI DAN UJI MUTU FISIK SEDIAAN BALSEM STICK DARI KOMBINASI RIMPANG JAHE (Zingiber officinale) DAN RIMPANG KENCUR (Kaempferia galanga L)," *FARMASAINKES J. Farm. SAINS, dan Kesehat.*, vol. 2, no. 2, hal. 145–155, 2023, doi: 10.32696/fjfsk.v2i2.1886.

[7] K. Yati, L. P. Dwita, L. Oktaviana, dan S. N. Gantini, "Minyak Jojoba Terhadap Sifat Fisik Balsem Stick Jintan Hitam (Nigella sativa L .) Dan Aktivitas," *Pros. Kolok. Dr. dan Semin. Has. Penelit. Hibah*, vol. 1, no. 1, hal. 563–572, 2018.

[8] M. Kiptiah, A. G. Ilmannafian, I. Darmawan, dan D. A. Yulianti, "Analisis Balsem Stik Aroma Serai Wangi (Citronella Oil)dengan Penambahan Minyak Jahe," *J. Teknotan*, vol. 16, no. 1, hal. 13–18, 2022.

[9] O. H. Purba, N. T. Tumanggor, A. Syafitri, L. Meliana, dan D. M. Simorangkir, "PEMBUATAN SEDIAAN BALSEM STICK DARI SEREH (Cymbopogon citratus (DC.) Stapf) SEBAGAI AROMATERAPI," *J. Penelit. Farm. Herb.*, vol. 3, no. 1, hal. 75–81, 2020, doi: 10.36656/jpfh.v3i1.326.

[10] S. Aisiyah, H. Reslely, N. Vivin, S. Titik, Suhartinah, dan K. Ilham, "Pelatihan Pembuatan Balsem Stik Gondopuro Di Wilayah Kerten Laweyan Surakarta Yang Berpotensi Sebagai Usaha Mandiri Warga," *J-ABDI J. Pengabdi. Kpd. Masy.*, vol. 3, no. 2, hal. 379–382, 2023, doi: 10.53625/jabdi.v3i2.6008.

[11] J. Wulandari, F. Fahrulsyah, T. N. Agasi, dan D. A. Z. Joen, "Karakteristik Sediaan Balsem Stick Dengan Variasi Formulasi Penambahan Minyak Daun Eucalyptus Globulus," *J. Pengemb. Agroindustri Terap.*, vol. 3, no. 1, hal. 48–63, 2024, doi: 10.25181/jupiter.v3i1.3452.

[12] Y. T. Handayani, S. D. Biadi, S. Rahmawati, A. Pebrian, T. B. Saputra, dan T. Tisnawan, "Formulasi Sediaan Balsam Dari Ekstrak Tanaman Kencur," *Indones. J. Heal. Sci.*, vol. 3, no. 2, hal. 192–198, 2023, doi: 10.54957/ijhs.v3i2a.455.

[13] L. S. Salsabila, I. Shafira, M. A. Azhar, G. A. S. Ryanti, R. Aurelia, dan M. A. H. Sitorus, "Formulasi Dan Evaluasi Balsam Aroma Terapi Menggunakan Minyak Lemon (Oleum Citri. L) Dengan Cera Alba Sebagai Stabilizing Agent," *Indones. J. Heal. Sci.*, vol. 3, no. 2, hal. 155–160, 2023, doi: 10.54957/ijhs.v3i2.448.

[14] S. M. N. Siregar, G. I. Dalimunthe, M. S. Lubis, dan R. Yuniarti, "A FORMULASI DAN UJI MUTU FISIK SEDIAAN BALSEM STICK DARI LENGKUAS (Alpinia galanga (L.) Willd) DAN LADA HITAM (Piper nigrum L.)," *J. Buana Farma*, vol. 2, no. 4, hal. 10–16, 2022, doi: 10.36805/jbf.v2i4.580.

[15] S. H. Anastasia dan T. Romadhonni, "Formulasi Sediaan Balsem Minyak Atsiri Tanaman Sereh (Cymbopogon nardus (L). Rendle)," *J. Glob. Heal. Sci.*, vol. 4, no. 3, hal. 105–108, 2019.

[16] L. Amatullah, T. N. Cahyaningrum, dan A. N. Fidyaningsih, "Antioxidants Effectivity In Skin Lotion Formulation Of Mesocarp Fruit Extract Lontar (Borassus Flabellifer) Against White Rats Wistar Male In-Situ," *JPSCR J. Pharm. Sci. Clin. Res.*, vol. 2, no. 01, hal. 25, 2017, doi: 10.20961/jpscr.v2i01.5236.

[17] N. R. I. Mukhlishah, N. Sugihartini, dan T. Yuwono, "Daya Iritasi Dan Sifat Fisik Sediaan Salep Minyak Atsiri Bunga Cengkih (Syzigium aromaticum) Pada Basis Hidrokarbon," *Maj. Farm.*, vol. 12, no. 1, hal. 372–376, 2016.

[18] Y. I. Masadi, T. Lestari, dan I. K. Dewi, "Identifikasi Kualitatif Senyawa Terpenoid Ekstrak n-Heksana Sediaan Losion Daun Jeruk Purut (Citrus hystrix DC)," *J. Kebidanan Dan Kesehat. Tradis.*, vol. 3, no. 1, hal. 32–40, 2018.

[19] R. F. Faruki, "FORMULASI DAN UJI AKTIVITAS KRIM ANTIOKSIDAN EKSTRAK ETANOL DAUN BINAHONG (Anredera cordifolia (Ten.) Steenis) DENGAN METODE DPPH (1,1-diphenyl-2-picrylhydrazil)," UIN Alauddin Makassar, 2021.

[20] T. Romadhonni, R. Prastyawati, E. Alfatheana, dan H. Sinaga, "Formulasi Sediaan Lotion Ekstrak Daun Jambu Biji (Psedium guajava L)," *Biogenerasi*, vol. 7, no. 1, hal. 180–188, 2022.

[21] N. Qamariah, R. Handayani, dan A. I. Mahendra, "Uji Hedonik dan Daya Simpan Sediaan Salep Ekstrak Etanol Umbi Hati Tanah," *J. Surya Med.*, vol. 7, no. 2, hal. 124–131, 2022, doi: 10.33084/jsm.v7i2.3213.