

Formulation and Evaluation of Anti-Acne Lotion Containing Red Ginger (*Zingiber officinale* Roscoe) Essential Oil

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Abstract

Red ginger (*Zingiber officinale* Roscoe) has been empirically used as antibacterial agent. This study was aimed to formulate anti-acne lotion containing red ginger essential oil and to evaluate its antibacterial activity against *Propionibacterium acnes* and *Staphylococcus epidermidis*. Extraction and distillation of 10 kg of red gingers were performed to obtain its essential oils. The lotions were prepared using oil in water (o/w) base with various concentration of red ginger essential oils, *i.e.*, 2.5%, 5%, and 7.5%. The lotion was assayed to determine organoleptic, homogeneity, pH, viscosity, and irritation-inducing level. Antibacterial activity test was conducted using disk-diffusion method. Results indicated that the 7.5% concentration exerted the strongest activity in inhibiting *P. acnes* (inhibition zone 12.4 mm) and *S. epidermidis* (inhibition zone 29 mm). In conclusion, anti-acne lotion containing 7.5% of red ginger essential oil was effective to control acne inducing bacteria and fulfilled the required standards.

Keywords: Red ginger, essential oil, anti-acne, *Propionibacterium acnes*, *Staphylococcus epidermidis*

Introduction

Acne is one of the most common skin disorders which is characterized by chronic inflammation of pilosebaceous units. Pathogenic mechanism of acne includes increased sebum production, *P. acnes* and *S. epidermidis* colonization, follicular hyperkeratinization, and the products of inflammation.¹

Red ginger (*Zingiber officinale* Roscoe) has been widely studied as a medicinal plant. Its secondary metabolites include flavonoids, phenols, glycosides, triterpenoid,

essential oils and tannins. Several previous studies showed that red ginger extract had anti-bacterial activity against *P. acnes*, *S. epidermidis*, *S. aureus* and *E. coli*.^{2,3} Essential oil of red ginger also exhibited potential anti-bacterial activity against *P. acnes*, *P. aeruginosa*, *S. aureus*, and *S. epidermidis*.^{4,6}

Nevertheless, there is limited information regarding formulation and evaluation of anti-acne lotion containing red ginger essential oil. Therefore, this study was conducted to formulate anti-acne lotion

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containing red ginger essential oil and to evaluate its anti-bacterial activity against *P. acnes* and *S. epidermidis*.

Methods

Materials and instruments

The materials used in this study included 10 kg of red ginger, PEG-40 hydrogenated castrol oil (Croduret 50 SS®), caprylic (Crodamol GTCC®), methyl paraben, propyl paraben, glycerin, 96% ethanol, distilled water, agar media, physiological natrium chloride, *P. acnes*, and *S. epidermidis* cultures. The instruments used included Brookfield viscometer (DV1-Prime®), homogenizer (IKA® RW 20 digital), pH-meter, and incubator.

Extraction of essential oil

Steam distillation was conducted at Bogor Spice and Medicinal Plant Research Center (Balitro) laboratory to obtain red ginger essential oil. A total of 10 kg of red ginger that had been washed and chopped were placed into a glass flask. Through an inlet, steam was injected to the flask, resulting in the vaporized compounds that subsequently underwent condensation process. The essential oil was then purified by adding Na₂SO₄ to eliminate water content. Characteristics of essential oil were examined based on Indonesian National Standard No. 061312-1998.

Formulation of anti-acne lotion

The lotions were prepared using oil in water

(o/w) base with various concentration of red ginger essential oils, *i.e.*, 2.5%, 5%, and 7.5%. The formula was based on previous research conducted by Indriati *et al.*⁷ The oil phase consisted of PEG-40 hydrogenated castrol oil and caprylic, while the water phase consisted of distilled water, methyl paraben, propyl paraben and glycerin. The oil and water phase were heated at 70 °C and mixed using homogenizer at 500 rpm for 15 minutes. Subsequently, ethanol was added after the temperature decreased. Essential oil was then added and mixed until homogenous.

Anti-bacterial activity test

Anti-bacterial activity tests against *S. epidermidis* and *P. acnes* were performed using disk-diffusion method. Acnol was used as positive control, while distilled water was used as negative control. 0.5 ml culture containing approximately 10×10⁶ bacteria was mixed into agar media solution until homogenous. It was then placed to sterile petri dish until solid. Subsequently, paper disk was placed on the media. Approximately 20 µl of lotions were injected on the paper disk. It was then incubated at 35 ± 2 °C for 24-48 hours. The inhibition zone was then measured using a ruler. Formula with the best antibacterial activity was assayed to determine its organoleptic, homogeneity, pH, viscosity, and irritation-inducing level. Homogeneity was evaluated by pressing the lotions which was placed on transparent glass with other transparent instrument to

Table 1. Characteristics of Red Ginger Essential Oil

Testing	Result	Requirement	Information
Physical testing:			
a. Color	Orange	Yellow - Orange	Qualified
b. Odor	Typical ginger aroma	Typical ginger aroma	Qualified
Density	0.8721	0.8720-0.8890	Qualified
Optical rotation	1.62 °C	(-32 °C)-(-14 °C)	Qualified
Refractive Index	1.487	1.4853-1.4920	Qualified

Table 2. Formulation of Lotion

Ingredients	Concentration (% w/w)			
	Base	Formula I	Formula II	Formula III
Essential oil of red ginger	-	2.5	5	7.5
PEG-40 hydrogenated castrol oil	24.5	24.5	24.5	24.5
Caprylic	5	5	5	5
Ethanol	5.25	5.25	5.25	5.25
Glycerin	5.25	5.25	5.25	5.25
Methyl paraben	0.18	0.18	0.18	0.18
Proph paraben	0.02	0.02	0.02	0.02
Distilled water	59.8	57.3	54.8	52.3

evaluate the presence of granules or particles which were not evenly mixed. pH was measured using digital pH-meter. Viscosity was measured using Brookfield viscometer (DV1-Prime®). Irritation test was conducted by applying lotion in the back of the hand for 24 hours. The presence of roughening, itching and redness on the skin were observed.^{8,9}

Results and Discussion

Distillation process of 10 kg of red ginger resulted in 24 ml of essential oils. We found

that our red ginger essential oil fulfilled all the requirements of Indonesian National Standard No. 06-1312-1998, indicating that this essential oil had good quality. The result can be seen in the Table 1.

Results indicated that lotion containing 7.5% of red ginger essential oil exerted the strongest activity in inhibiting *P. acnes* (inhibition zone 12.4 mm) and *S. epidermidis* (inhibition zone 29 mm). The lowest anti-bacterial activity was shown by formula I, which contained

Table 3. Anti-bacterial Activity of Red Ginger Essential Oil Lotion

Bacteria	Sample	Inhibition Zone (mm)			Mean (mm)
<i>P. acnes</i>	Positive control	18	17	17	17.3
	Negative control	0	0	0	0
	F0	0	0	0	0
	F1	8	8	8	8
	F2	16	17	16	16.3
	F3	30	28	29	29
<i>S. epidermidis</i>	Positive control	18	17	17	17.3
	Negative control	0	0	0	0
	F0	0	0	0	0
	F1	7	7	7	7
	F2	9	8	8	8.3
	F3	12	13	12	12.3



Figure 1. Results of the Skin Irritation Test
A: Skin Condition at Initial Application of Lotion.
B: Skin Condition After 24 Hours Post-Application

5% of red ginger essential oil. Formula III had greater inhibition zone compared to positive control against *P. acnes*, but had slightly smaller inhibition zone against *S. epidermidis*.

Organoleptic examination was intended to evaluate physical properties of the lotion. Results showed that the lotion was yellow, had distinctive aroma of ginger, and had no sediment. Homogeneity test was performed since it is critical to ensure the active substances are dispersed evenly in the base formula. Results showed that the lotion was homogeneous and met the desired criteria.

The degree of acidity (pH) is a very important parameter in a cosmetic product because the pH of cosmetics influences its absorption on the skin. Cosmetics with very high or low pH are likely to induce irritation. The results showed that the pH of the lotion was 7.42. The pH requirements for cosmetic preparations range from 4.5 to 7.5.^{10,11}

Viscosity is a measure of a fluid resistance to flow. Viscosity may affect skin retention of the dosage form.¹⁰ The results showed that the viscosity of the lotion was 526 cP, which fulfilled the requirement from of Food

and Drug Administration (viscosity of a good lotion should be < 30,000 cP).¹²

Irritation test was performed to evaluate the occurrence of side effects on the skin. The 24-hours observation showed that the lotion did not cause itching and inflammation of the skin, implying that the formula did not induce skin irritation. Further study is encouraged to evaluate long-term stability and effectiveness of red ginger essential oil lotion.

Conclusions

Anti-acne lotion containing 7.5% of red ginger essential oil was effective to control acne inducing bacteria and fulfilled the required standards.

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Conflict of interest

None declared.

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