Jurnal Ilmiah Farmako Bahari

Journal Homepage : https://journal.uniga.ac.id/index.php/JFB

ANTIBACTERIAL ACTIVITY OF JAVA PREANGER GEL FROM CHERY COFFEE EXTRACT AND GREEN BEAN COFFEE (*Coffea arabica* L.) AS ANTI-ACNE

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ARTICLE HISTORY

Received: 6 April 2023 | Revised: 26 June 2023 | Accepted: 10 July 2023

Abstract

Acne is a skin condition marked by *nodules, papules*, and pustules. Antibiotic treatment for acne frequently results in resistance. In the meantime, skin irritation is brought on by using several anti-acne drugs. Coffee arabica (*Coffea arabica* L.) Java preanger has a chlorogenic acid molecule with antibacterial properties against *Propionibacterium acnes*. This study examined the antibacterial activity of coffee cherry seed extract and green bean arabica coffee (*Coffea arabica* L.) Java preanger to determine which had the superior anti-acne action. The gel composition contained 2% carbopol and 3%, 6%, and 9% coffee cherry extract concentrations, and 5%, 10%, and 15% coffee green bean extract concentrations. The obtained formulations were tested for physical and antibacterial efficacy against *Propionibacterium acne*. The physical evaluation of the formulations included organoleptic testing, homogeneity, pH, viscosity, spreadability, and antibacterial activity tests. The formulations that met the quality requirements for cherry coffee and coffee green bean gel were selected based on the findings of the physical evaluation. While formula three at a concentration of 9% coffee cherry seed extract has the best antibacterial activity with an inhibition of 15.27 mm, green bean coffee at 15% has an inhibition of 17.30 mm.

Keywords: acne, antibacterial, arabica coffee, gel, java preanger

Introduction

The three principal layers of skin are the epidermis, dermis, and hypodermis. The epidermis, as the outermost layer, is frequently exposed to stimuli and negative environmental impacts, which can lead to various disorders, including acne.[1,2]

Acne is one of the most common *skin illnesses*, particularly among adolescents. This skin illness is typically caused by inflammation of the pilosebaceous follicles, which manifests as nodules, papules, and pustules. *Propionibacterium acne, Staphylococcus epidermis*, and *Staphylococcus aureus* cause acne inflammation, leading to acne production.[3,4]

Currently, clindamycin, erythromycin, doxycycline, and tetracycline are used to treat acne. However, antibiotic use frequently results in resistance and immune hypersensitivity. Other anti-acne medications irritate the skin, such as salicylic acid, benzoyl peroxide, sulfur, retinoid, asam azelaic, and resorcinol. Natural antibacterials are recognized to be far safer than manufactured compounds. Arabica coffee (*Coffea*

arabica L.) Java preanger is one of the natural components that have the potential to be anti-acne.[5]

Chlorogenic acid, caffeine, trigonelline, polysaccharides, triglycerides, linoleic fatty acids, and essential oils are all found in Coffee arabica (*Coffea arabica* L.) Java preanger.[6] Arabica coffee (*Coffea arabica* L.) Java preanger possesses anti-cellulite, exfoliant (to remove dead skin cells), antioxidant, and antibacterial effects.[7,8,9]

There has been no research on the anti-acne activity of arabica coffee (*Coffea arabica* L.) Java preanger bean extract either in cherry or green bean form. As a result, this study aims to create a gel formulation and compare the anti-acne activity of coffee cherry extract and arabica coffee green bean extract to determine which has the best anti-acne training.

Alternative Anti-acne drugs are typically administered in the form of a gel. This preparation was chosen because it can deliver anti-acne ingredients to specific targets, namely acne-causing bacteria, has a pleasant skin feel, offers a cooling impact on the face, dries quickly, and can produce a film readily washed away with water.[10]

Materials and Method

This experiment involved making extracts, assessing them for antibacterial activity, making gel preparations, evaluating the gel preparations, and testing the antibacterial activity of the gel preparations.

Instruments

Analytical balance (Shimazu Aty 224r), spatula, evaporator cup, stir bar, beaker (Pyrex), measuring cup (Pyrex), dropper pipette, test tube, bunsen burner, evaporator cup, mechanical stirrer electrical (Precise Digital Overhead stirrer), Erlenmeyer, electric stove, pH meter, viscometer (Brookfield), autoclave (YX-18HDD), caliper, petri dish (Pyrex), oven (Dzf-6050), incubator (Memmert IN55), vortex (Gemmy VM-300), wire loops and tools commonly used in Pharmaceutical technology laboratory liquid semi-solid preparations.

Materials

The materials used in this study include: Cherry seeds and green bean Arabica coffee (*Coffea Arabica* L.) Java preanger obtained from Mount Manglayang coffee plantations in Sumedang, West Java, carbopol 940, Triethanolamine (TEA) (Bratacheum), propylene glycol (Bratacheum), methylparaben (Bratacheum), propylparaben (Bratacheum), distilled water, 96% ethanol, and *Propionibacterium acne* (Laboratorium parasitology Fakultas Kedokteran Universitas Indonesia)

Experimental Procedure

Material collection

Arabica coffee beans (*Coffea arabica* L.) Java preanger were obtained from Mount Manglayang, Pengadean Village, Sumedang Regency. Furthermore, plant determination was carried out at the Biology Research Center, Indonesian Institute of Sciences, Cibinong.

Production of extract

Green bean arabica coffee (*Coffea arabica* L.) Java preanger with coffee cherry powder was extracted using a maceration process with 96% ethanol solvent, and the filtrate obtained was thickened with a rotary evaporator at 40-50^{o}C at 50 rpm for 10 minutes. The resulting extract was next evaluated for antibacterial activity against the bacteria *Propionibacterium acne.*

ISSN: 2087-0337
E-ISSN: 2715-9949

Formulation of anti-acne gel preparations

The formulation for the anti-acne gel is created using the best Carbopol 940 2% base orientation results. Furthermore, anti-acne gel formulations were created using various concentrations of arabica coffee cherry extract (3%, 6%, and 9%), as well as green coffee bean extract (5%, 10%, and 15%) (Table 1 and Table 2). The concentration was established based on the findings of each extract's antibacterial activity test.

Table 1. Formulation of Anti-Acne Gel Cherry and Arabica Coffee (*Coffea arabica* L.) Java Preanger

Materials	Concentration (%) b/v		
	F1	F2	F3
Cherry and coffee extract	3	6	9
Carbopol 940	2	2	2
Propylene glycol	10	10	10
Methyl paraben	0.02	0.02	0.02
Propylparaben	0.02	0.02	0.02
TEA	0.5	0.5	0.5
Aquadest	*Ad* 100	*Ad* 100	*Ad* 100

Table 2. Anti-Acne Gel Formulation Green Bean Arabica Coffee (*Coffea arabica* L.) Java Preanger

Materials	Concentration (%) b/v		
	F1	F2	F1
Green coffee bean extract	5	10	15
Carbopol 940	2	2	2
Propylene glycol	10	10	10
Methyl paraben	0.02	0.02	0.02
Propylparaben	0.02	0.02	0.02
TEA	0.5	0.5	0.5
Aquadest	*Ad* 100	*Ad* 100	*Ad* 100

Production of anti-acne gel

Carbopol is dissolved in water and added to the carbopol mixture after being created in hot water 20 times the amount of carbopol. TEA is gradually added to the mixture after propylparaben has been dissolved in propylene glycol until a translucent mass of the desired thickness is formed. Coffee extract is mixed into the gel base formulation, and water is added until completely dissolved.

Gel physical evaluation

The physical stability of gel formulations made from cherry and coffee extracts, as well as coffee green bean, was then assessed:

Organoleptic

The anti-acne gel preparations obtained were then observed organoleptically, including color, smell, and consistency. For 28 days, this examination is conducted once a week.

Homogeneity

Homogeneity was evaluated using a glass object; as much as 1 g of anti-acne gel preparation was smeared on a glass object plate, then flattened and observed under a microscope. This evaluation is carried out every week for 28 days.

ISSN: 2087-0337
E-ISSN: 2715-9949

pH
As much as 1 g of anti-acne gel preparation is taken and dissolved in 20 mL of water, then measure the solution using a pH meter. This evaluation is carried out every week for 28 days.

Viscosity
Viscosity evaluation was carried out using a Brookfield viscometer. As much as 100 ml of the preparation is put into a glass beaker, the spindle (Number 7) is attached to the viscometer, and the tool is run. The scale that shows the thickness of the preparation is recorded and calculated. This evaluation is carried out every week for 28 days.

Spreadability test
The spreadability test of the gel preparation was carried out using mica paper, millimeter block paper, and 150 g weights. A total of 1 g of anti-acne gel preparation was placed on mica paper, then covered again with mica. Record the diameter obtained as L1, then put a 150 g load on it, let it stand for 1 min, then record the increase in area as L2. The spreadability test can be calculated using the formula:
S = M.L/T, where S (power spread), M (mass), L(diameter), and T (time (seconds)
(t in a sec) with g.cm/sec unit.

Preparations were observed at t0, then t7, t 14, t 21 to t28. The results of the evaluation then looked at the most stable formula of the two types of coffee that were made.

Antibacterial test activity

A sterile petri dish was filled with 200 µL of the tested bacterial solution, followed by 20 mL of still-liquid MHA medium. The medium is allowed to harden after gently shaking until homogenous. The medium was perforated using a perforator, and up to 50 µL of each concentration variation of the extract solution was placed in a distinct reserve hole. For 18-24 hours, the plates were incubated at 37^{o}C. The clean zone around the reserved spot, formed by the extract's bacterial growth restriction, demonstrates the extract's antibacterial efficacy. For each recipe, measurements were taken three times, and the average value of the antibacterial effect was computed.

Results and Discussion

Physical Characteristics of Gel

Organoleptic observations revealed that all formulae, including the coffee cherry gel formula and the coffee green bean formula, did not change in color, fragrance, or texture during storage. Similarly, the homogeneity test revealed that the preparation remained homogeneous from the initial day of manufacture to the end of the 28-day storage period.

The pH observations revealed a difference: the higher the concentration of coffee extract, the lower the pH of the preparation due to the acidic nature of the coffee extract, which comes from chlorogenic acid compounds, and the longer it is stored, the lower the pH of the preparation, because degradation occurs during storage, causing the pH of the practice to decrease. The gel from coffee green bean extract, on the other hand, has a higher acidity level than coffee cherry.

The viscosity measurements revealed that the higher the extract concentration added, the lower the viscosity of the preparation. The extract's acidic nature can break down the fiber in the carbopol gelling ingredient, causing it to become thinner (lower

ISSN: 2087-0337
E-ISSN: 2715-9949

viscosity). However, the three formulations, cherry coffee, and green bean coffee,e can still meet the standards.

Observations on the spreadability of the preparation demonstrate that the higher the concentration of the extract added, the greater the spreadability because the more dilute the preparation, the wider the spreadability, and vice versa. The results of the spreadability evaluation of each formula still meet the test standards, namely between 5-7g.cm/sec, and this figure may be described as comfortable in usage (Figure 1 and Figure 2).

Figure 1. Anti-acne gel arabica coffee and cherry extract where :
F1: Gel preparation with 3% cherry extract
F2: Gel preparation with 6% cherry extract
F3: Gel preparation with 9% cherry extract

Figure 2. Anti-acne gel arabica coffee green bean extract where :
F1: Gel preparation with 5% green bean extract
F2: Gel preparation with 10% green bean extract
F3: Gel preparation with 15% green bean extract

Tables 3 and 4 show the physical characteristics of gel formulations made with coffee, cherry extract, and green bean arabica coffee (*Coffea arabica* L.) Java preanger.

ISSN: 2087-0337
E-ISSN: 2715-9949

Table 3. Physical Characteristics of Anti-Acne Gel Arabica Coffee and Cherry (*Coffee arabica* L.) Java Preanger

Characteristics	Formula		
	F1	F2	F3
Organoleptic			
Color (T_0 -T_{28})	Brownish-yellow +	Brownish-yellow ++	Brownish-yellow +++
Aroma (T_0 -T_{28})	Distinctive aroma	Distinctive aroma	Distinctive aroma
Texture (T_0 -T_{28})	Soft	Soft	Soft
Homogeneity(T_0-T_{28})	Homogeneous	Homogeneous	Homogeneous
pH (T_0-T_{28})	5.30	5.10	4.90
Viscosity (T_0-T_{28})	77,800	59,000	46,000
Spreadability (T_0-T_{28})	6.81	6.91	7.05

T: Time (day)

Table 4. Physical Characteristics of Anti-Acne Gel Green Bean Arabica Coffee (*Coffea arabica* L.) Java Preanger

Characteristics	Formula		
	F1	F2	F3
Organoleptic			
Color (T_0 -T_{28})	Brownish-yellow +	Brownish-yellow ++	Brownish-yellow +++
Aroma (T_0 -T_{28})	Distinctive aroma	Distinctive aroma	Distinctive aroma
Texture (T_0 -T_{28})	Soft	Soft	Soft
Homogeneity(T_0-T_{28})	Homogeneous	Homogeneous	Homogeneous
pH (T_0-T_{28})	5.01	4.80	4.70
Viscosity (T_0-T_{28})	34,800	30,000	29,300
Spreadability (T_0-T_{28})	7.16	7.66	8.33

T: Time (day)

Antibacterial Activity

The gel formulation was next evaluated for antibacterial activity against *Propionibacterium acne* germs three times the replication. The findings of the activity tests revealed that the greater the extract concentration utilized, the larger the inhibition zone created.

ISSN: 2087-0337
E-ISSN: 2715-9949

Table 5. Antibacterial Activity of Gel from Cherry and Arabica Coffee (*Coffea Arabica* L.) Java Preanger Extract

Tested Bacteria	Formula	Obstacle zone (mm)
Propionibacterium acnes	F0	-
	Comparison formula*	28.88±0,06
	F1	10.06±0,10
	F2	13.07±0,58
	F3	15.27±0,73

*Comparison formula: Clindamycin gel

Table 6. Antibacterial Activity of Gel from Green Bean Arabica Coffee (*Coffea arabica* L.) Seed Extract Java Preanger

Tested Bacteria	Formula	Obstacle zone (mm)
Propionibacterium acnes	F0	-
	Comparison formula*	28.88±0,06
	F1	11.30±0,33
	F2	15.50±0,63
	F3	17.30±0,50

*Comparison formula: Clindamycin gel

The antibacterial activity of gel preparations containing 3%, 6%, and 9% concentrations of coffee and cherry extract and 5%, 10%, and 15% concentrations of coffee green bean extract was tested in clear zones surrounding the wells. On the other hand, the activity test results revealed that green bean arabica coffee extract had a higher inhibition value of 17.30 mm. In contrast, the coffee cherry extract had a lower inhibition value of 15.27 mm. It is because coffee green bean extract contains more chlorogenic acid than coffee cherry extract. As a result, it has increased antibacterial activity. Both varieties of coffee, cherry coffee, and green bean coffee, fall under the antibacterial category.

Conclusion

According to research on anti-acne gel formulations, carbopol 940 2% produces the best gel basis. With an inhibition value of 15.27 mm, the coffee cherry extract anti-acne gel formulation had the best propionibacterium acne antibacterial activity in the formula (F3). In contrast, the coffee green bean extracts anti-acne gel formulation had the best activity in the formula (F3). However, when comparing the two varieties of coffee, the coffee green bean extract has a higher acidity level of 4.37, while the coffee cherry has a lower acidity level of 6.19.

Acknowledgment

We thank the Pharmacy Study Program, Faculty of Mathematics and Natural Sciences (FMIPA), University of Garut, for all the facilities used during this research.

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ISSN: 2087-0337
E-ISSN: 2715-9949

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