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ANTIBACTERIAL ACTIVITY OF FOOT SPRAY OF TELANG FLOWER EXTRACT AND COFFEE GROUNDS

AKTIVITAS ANTIBAKTERI FOOT SPRAY EKSTRAK BUNGA TELANG DAN AMPAS KOPI

Susilo Yulianto *, Miftaqul Jannah, Makhabbah Jamilatun

Department of Pharmaceutical and Food Analysis, Surakarta Ministry of Health Polytechnic, Surakarta, Indonesia

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A B S T R A C T

Background: *Foot odor is a problem that often occurs, one of the causes being the Staphylococcus aureus bacteria which contaminates sweaty feet and dirty shoes. Foot spray can be used to reduce foot odor. Telang flowers (butterfly pea) and coffee grounds can be formulated in foot spray to reduce foot odor because they have a distinctive aroma and contain flavonoid compounds as antibacterials.* ***Purpose:*** *This research aims to determine the antibacterial activity of foot spray using telang flower extract and coffee grounds against Staphylococcus aureus.* ***Method:*** *The research was conducted using the disc diffusion method. Foot spray was made in three formulas with varying concentrations of telang flowers and coffee grounds, namely I (0.5 : 0.125), II (1 : 0.25), and III (2 : 0.50).* ***Result:*** *The test results of three formulas showed yellow, orange and brownish purple colors, a distinctive odor of menthol, pH 4.54 - 4.56, viscosity 4.00 – 6.00 Cp and dry time 1 minute 1 second – 1 minute 53 seconds. The antibacterial activity test showed that foot spray had antibacterial activity against Staphylococcus aureus with the diameter of the inhibition zone in Formulas I and II in the medium category, while in III it was in the strong category. This shows that the higher the concentration of telang flowers and coffee grounds, the greater the antibacterial activity.* ***Conclusion:*** *Foot spray made from telang flower extract and coffee grounds could reduce foot odor by inhibiting the growth of Staphylococcus aureus bacteria.*

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Correspondence:
Susilo Yulianto

E-mail :
susilo_yulianto14@yahoo.co.id

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A B S T R A K

Latar belakang: Bau kaki merupakan masalah yang sering terjadi, salah satu penyebab bau kaki yaitu bakteri *Staphylococcus aureus* yang mengkontaminasi kaki berkeringat dan sepatu yang kotor, untuk mengurangi bau kaki dapat digunakan *foot spray*. Bunga telang dan ampas kopi dapat diformulasikan dalam *foot spray* untuk mengurangi bau kaki karena memiliki aroma yang khas dan mengandung senyawa flavonoid sebagai antibakteri. **Tujuan:** Penelitian ini bertujuan mengetahui aktivitas antibakteri *foot spray* ekstrak bunga telang dan ampas kopi terhadap bakteri *Staphylococcus aureus*. **Metode:** Metode penelitian ini yaitu metode difusi cakram. *Foot spray* dibuat dalam tiga formula dengan variasi konsentrasi bunga telang dan ampas kopi yaitu I (0.5 : 0.125), II (1 : 0.25), dan III (2 : 0.50). **Hasil:** Hasil pengujian tiga formula menunjukkan warna kuning, jingga, dan ungu kecoklatan, bau khas dari mentol, pH 4.54 - 4.56, viskositas 4.00 – 6.00 Cp dan waktu kering 1 menit 1 detik – 1 menit 53 detik. Uji aktivitas antibakteri, menunjukkan bahwa *foot spray* memiliki aktivitas antibakteri terhadap *Staphylococcus aureus* dengan diameter zona hambat pada Formula I dan II dengan kategori sedang, sedangkan pada III dengan kategori kuat. Hal ini menunjukkan semakin tinggi konsentrasi bunga telang dan ampas kopi, maka semakin besar aktivitas antibakterinya. **Kesimpulan:** *Foot spray* ekstrak bunga telang dan ampas kopi dapat mengurangi bau kaki dengan cara menghambat pertumbuhan bakteri *Staphylococcus aureus*.

Kata kunci:
Ampas kopi, *Foot spray*, Bunga telang

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INTRODUCTION

Dense daily routines make people sweat during activities (Ekawarna, 2021). One part of the body that often experiences sweating with more frequency and to a greater degree is the feet because that part is often covered by the use of socks and shoes (Hajar *et al*., 2022). The closed condition of the feet, supported by high or hot temperatures, can be a factor in causing foot problems, one of which is bad odor or foot odor (Ashfia *et al*., 2019). Foot odor can arise due to sweat mixed with bacteria (Setiawan and Suling, 2018; Vernanda *et al*., 2023) including *Corynebacterium* acne, *Pseudomonas aeruginosa*, *Staphylococcus epidermidis*, *Staphylococcus aureus,* and *Streptococcus pyogenesis* (Primono, 2019).

A foot spray can be used as a solution because it dries faster and is more practical (Amananti and Dairoh, 2020; Riyanta *et al*., 2020; Rumanasen, 2022). Foot spray typically contains 62% ethanol, a softener, and moisturizer (Ashfia *et al*., 2019). The active ingredient is alcohol as an antimicrobial agent because it is most effective against bacteria (Hutapea and Musfiroh, 2021). Excessive consumption of alcohol and chemicals can be harmful to health and can cause skin irritation (Kurniawidjaja *et al*., 2021). Therefore, its use should be limited by adding active ingredients from natural ingredients that can have antibacterial properties. The natural ingredients are coffee grounds and telang flowers (Ashfia *et al*., 2019).

Telang flower (*Clitoria ternateae L*.) can be used as traditional medicine. According to Styawan and Rohmanti (2020), flavonoids and alkaloids from the telang flower plant have the potential as antibacterial (Zahara, 2022). The antimicrobial activity of methanol extracts was carried out on bacteria, yeast, and fungi (Febrianti *et al*., 2022). The pharmacological potential of telang flowers includes antibacterial, antioxidant, anti-inflammatory, antihistamine, antidiabetic, antiparasitic, anticancer and, immunomodulatory (Pangondian *et al*., 2023). Coffee is a brewed drink that is well-known to the public. When coffee is processed into a beverage, usually the waste produced is in the form of coffee grounds. The remaining coffee grounds still contain ingredients such as caffeine, organic acids, and antioxidants, although not as much as pure coffee grounds (Faesi *et al*., 2020; Rochmah *et al*., 2021), and the aroma of coffee grounds can be used to remove unpleasant odors because it has a distinctive odor (Primono, 2019). Coffee also has detoxification properties, removes mosquito scars/bites, improves blood circulation, increases skin metabolism, and makes skin healthier and stronger (Limantara *et al*., 2019; Iriondo-DeHond *et al*., 2020; Michalak *et al*., 2021). Based on the above background, the researcher conducted a study entitled antibacterial activity of foot spray preparations of telang flower extract and coffee grounds, with the aim of knowing the physical quality and antibacterial activity of foot spray against *Staphylococcus aureus*.

MATERIAL AND METHOD

The type of research is laboratory experimental. This research describes the results of physical quality evaluations which include organoleptic tests, pH tests, viscosity tests, dry time tests, and antibacterial activity test results for foot spray preparations of telang flower extract and coffee grounds. The independent variable in this research is the variation in concentration of telang flower extract and coffee grounds in the foot spray preparation of butterfly telang extract and coffee grounds, while the dependent variable is the inhibition zone formed and physical quality evaluation. Positive and negative controls are used in antibacterial tests, to compare the antibacterial activity of foot spray against standard antibiotics (positive control) and substances that do not contain antibacterial activity (negative control).

Materials

The research materials include robusta coffee, pure culture of *S.aureus* bacteria, telang flower, coffee grounds, ethanol 96% (pharmaceutical grade), ascorbic acid, glycerin, isopropyl alcohol, menthol, propylene glycol, carbopol 940, NaOH, Tween 80, aquadest, muller hinton agar (*Oxoid*), NaCl 0.9%, chloramphenicol 1% (*Kalmicetine*), paper, cotton, disc paper, filter paper, and rubber bands. Research tools include beaker glass (*Pyrex*), test tube (*Pyrex*), petri dish (*Pyrex*), evaporation dish, sterile paper disc, stirring rod, ose, bunsen, oven, blender, autoclave, maceration vessel, brown vessel, rotary evaporator, waterbath, stirrer, pH meter, brookfield viscometer, erlenmeyer, hot plate, autoclave (*Hirayama*), LAF, tweezers, paper disk, and analytical balance (*Labex*).

Method

This research was carried out in several stages of implementation including extraction by maceration method, making foot spray formula, organoleptic test, pH test, viscosity test, dry time test, and antibacterial activity test from foot spray preparations of telang flower extract and coffee grounds. Descriptive analysis of the results was used to see whether the foot spray had good physical quality and antibacterial activity as an antibacterial against *Staphylococcus aureus* bacteria and for butterfly pea flower extraction, 400 grams of telang flower simplicia powder were put into a vessel. Then, 3.000 mL of 70% ethanol solvent was added in a ratio of 1 : 7.5, soaked for two days, stirring occasionally, stored in a dark place protected from sunlight, then filtered using filter paper until macerate was obtained. The mass obtained was collected in a brown vessel. The dregs obtained were macerated once for one day with 1000 mL of the same solvent in a ratio of 1 : 2.5 while stirring occasionally and stored in a dark place protected from sunlight. It was filtered using filter paper until macerate was obtained. The ethanol extract filtrate

of the butterfly telang was evaporated using a rotary evaporator at a temperature of 60 °C to obtain a thick ethanol extract of the butterfly telang.

Robusta coffee grounds extraction was performed with 200 grams of robusta coffee flower simplicia powder weighed and put into a vessel and 2000 ml of 96% ethanol solvent added. Then it was stirred until homogeneous and let sit for 24 hours. After 24 hours, it was filtered and evaporated to remove the solvent until a thick extract of coffee grounds was obtained. The telang flower extract and coffee grounds were stored in a container for use in the formulation stage. Making foot spray formulations is as listed in Table 1.

There are several physical quality tests for foot sprays. The physical quality analysis method and antibacterial activity test refer to previous research, which includes organoleptic tests (Jamilatun *et al*., 2023a), the pH test (Jamilatun *et al*., 2023a), homogeneity test (Jamilatun *et al*., 2023b), the viscosity test (Afifah *et al*., 2022), the dry time test (Ashfia *et al*., 2019), and antibacterial activity as an antibacterial against *Staphylococcus aureus* (Ashfia *et al*., 2019; Jamilatun *et al*., 2020).

Table 1. Foot spray formulation

Ingredient	Formula (%b/v)				Material function
	Formula I	Formula II	Formula III	Control	
Telang flower extract	0.5	1	2	-	Active substance
Coffee grounds extract	0.125	0.25	0.50	-	Active substance
Ascorbic acid	0.2	0.2	0.2	0.2	Antioxidant Stabilizer
Glycerin	0.2	0.2	0.2	0.2	Emolien
Isopropyl alcohol	5	5	5	5	Kosolven
Menthol	1	1	1	1	Freshener
Propylene glycol	5	5	5	5	Kosolven
Carbopol 940	0.06	0.06	0.06	0.06	Basic
NaOH	0.024	0.024	0.024	0.024	Basic
Tween 80	4.3	4.3	4.3	4.3	Solubiling agent
Aquades	Ad 100	Ad 100	Ad 100	Ad 100	Solvent

RESULT

Based on the weight of the ingredients and the thick extract obtained can be seen in Table 2, the yield obtained was 12.8% for telang flower and 5.35% for coffee grounds.

Table 2. Maceration extraction results

	Material weight (grams)	Thick Extract (grams)	Yield (%)
Telang flower simplicia powder	400	51.2	12.8
Coffee ground powder	200	10.7	5.35

Organoleptic test

The organoleptic test was carried out using the five senses to determine the form, smell, and color of the foot spray preparations of telang flower extract and coffee grounds can be seen in Table 3. In Formula I, Formula II, and Formula III, respectively, they have a yellow color with a characteristic menthol aroma, orange with a distinctive menthol aroma and brownish purple with a distinctive menthol aroma. The control has a grayish white color and a distinctive menthol aroma.

Table 3. Organoleptic test results

Formula	Organoleptic test		
	Form	Smell	Color
Negative control	Liquid	Special menthol	Gray white
Formula I			Yellow
Formula II			Orange
Formula III			Brownish purple

pH test

This research was conducted using a pH meter with a pH standard for topical preparations of 4.5 - 8 (SNI 06 - 2588 -1992). Based on the results of the pH test can be seen in Table 4 that has been carried out, the spray preparation has a pH of 4.54 – 4.58.

Table 4. pH test results

Formula	pH
Negative control	4.58
Formula I	4.54
Formula II	4.55
Formula III	4.56

Viscosity test

This viscosity measurement uses a Brookfield Viscometer. Viscosity test results can be seen in Table 5. Foot spray preparations have viscosity test results in the formula without the addition of extracts Formulation I, Formulation II, and Formulation III, respectively: 4.60, 4.00, 5.00, and 6.00.

Table 5. Viscosity test results

Formula	Viscosity (Cp)
Negative control	4.60
Formula I	4.00
Formula II	5.00
Formula III	6.00

Dry time test

The dry time test was carried out by spraying the preparation onto the soles and backs of the feet. In the dry time test, the results are shown in Table 6. The results of the dry time test of foot spray preparations for control, Formulations I, II, and III were in accordance with the requirements, namely drying in less than five minutes.

Table 6. Dry time test results

Formula	Time
Negative control	2 minutes 32 seconds
Formula I	1 minute 2 seconds
Formula II	1 minute 53 seconds
Formula III	1 minute 1 second

Antibacterial test

The results of the antibacterial test for foot spray preparations of telang flower extract and coffee grounds can be seen in Table 7. The results of the inhibition showed that the higher the concentration given, the greater the zone of inhibition produced in inhibiting *Staphylococcus aureus* bacteria.

Table 7. Antibacterial test results

Formula	Inhibition zone (mm)	Category
Positive control	29.14	Very strong
Negative control	-	-
Formula I	6.48	Medium
Formula II	7.45	Medium
Formula III	11.77	Strong

DISCUSSION

In this research, three formulations were made with controls. This aims to monitor the effectiveness of different extracts related to their antibacterial activity. Formulas I, II, and III each contained an extract of telang flower with a concentration of 0.5 %, 1 %, and 2 %, respectively and coffee grounds extract with a concentration of 0.125 %, 0.25 %, and 0.50 %, respectively. The control does not contain telang flower extract and coffee grounds. This formula also functions as a negative control.

Carbopol, an acrylic acid polymer, has stable hydrophilic properties. The spray preparation is made slightly viscous, to maintain the stability of the content in the preparation. The preparation of spray preparations uses one component of the gel complex, namely, carbopol – NaOH, which has a low concentration ratio (0.06 : 0.024), so that the spray preparation can still flow, but is slightly viscous. The concentration comparison was obtained after optimization of the formed preparation (Tsabitah *et al*., 2020; Amelia, 2021). The carbopol base was chosen because it has excellent compatibility with the ingredients in the formulation. Carbopol, when used for cosmetic preparations, does not leave marks when used, thus providing comfort for the user. A good carbopol used for the formulation of cosmetic preparations is carbopol 940 (Tsabitah *et al*., 2020; Amelia, 2021).

Carbopol in the pH range 4.5 - 10 turns thick. In addition, the expected pH of cosmetic preparations is around the skin pH range, 4.5 - 6.5. So the preparation is made in this range, by mixing the preparation using a homogenizer. The RPM value refers to the speed at which the polymer can form slowly and carefully, so as not to form large agglomerates (Tsabitah *et al*., 2020; Amelia, 2021). The organoleptic test was carried out to determine the shape, smell, and color of the preparations made (Aznury *et al*., 2020; Robiatun *et al*., 2022). The organoleptic test was carried out using the five senses to determine the shape, smell, and color of the foot spray preparations of telang flower extract and coffee grounds. The results of the organoleptic test showed that the foot spray extract from butterfly pea flowers and coffee grounds had organoleptic foot spray without the addition of the extract in the form of a liquid with a distinctive smell of menthol and a cloudy white color. Formulation I, it has a liquid form with a characteristic odor of menthol and a cloudy yellow color. The Formulation II, it has a liquid form with a characteristic odor of menthol and a cloudy orange color and for Formulation III it has a liquid form with a characteristic odor of menthol and a brownish purple color.

A pH test is carried out to determine the size of the acidity and base of a solution (Ashfia *et al*., 2019). The pH test was carried out using a pH meter by taking 10 ml of foot spray preparations of telang flower extract

and coffee grounds, then checking with a pH meter and reading the results. The pH value of foot spray preparations for control, Formulations I, II, and III were by the standard (SNI 06 - 2588 - 1992) which was 4.5 - 8.

The viscosity test aims to determine the level of viscosity of preparation because viscosity is one of the factors that affect consumer acceptance of a foot spray product. This viscosity measurement uses a Brookfield Viscometer. The viscosity of the tested foot spray can be compared with the viscosity of a known substance, namely water, which is 0.8904 Cp (Ashfia *et al*., 2019). The results obtained were compared with the viscosity of water and it was found that the viscosity of the foot spray preparation was higher because it was thicker than water.

The dry time test aims to determine how long it takes the foot spray preparation to dry on the skin of the feet (Ashfia *et al*., 2019). A good spray preparation has a drying time of less than five minutes (Afifah *et al*., 2022). The results of the dry time test of foot spray preparations for control, Formulations I, II, and III were by the requirements, namely drying in less than five minutes.

The antibacterial activity test of foot spray of telang flower extract and coffee grounds was carried out on the growth of *Staphylococcus aureus* by the agar diffusion method using the disc method on MHA agar media. The antibacterial activity of foot spray preparations of telang flower extract and coffee grounds were in the moderate category for Formulations I and II, with strong categories for Formulation III. The inhibition area of 10 - 20 mm is in the strong category, the inhibition area of 5 - 10 mm is in the moderate category and the inhibition area of 5 mm or less is in the weak category.

Chloramphenicol 1% positive control showed activity against *Staphylococcus aureus* with a very strong category that is more than 20 mm. Chloramphenicol exerts an antibacterial effect by inhibiting protein synthesis in bacteria. The negative control in the test did not produce an inhibitory zone, so it can be concluded that the addition of telang flower extract and coffee grounds to the foot spray preparations gave moderate antibacterial activity against *Staphylococcus aureus*. Telang flower extract has antibacterial activity against the bacteria S*taphylococcus aureus* because it has secondary metabolites alkaloids, flavonoids, tannins, and saponins (Maulid and Hanung, 2021) Likewise, coffee extract has antibacterial activity against bacteria *Staphylococcus aureus*, because it has secondary metabolites alkaloids. There is a base group in the alkaloid which, when it comes into contact with bacteria, will react with acid compounds amino acids that make up cell walls and bacterial DNA causes cells to be damaged (Yaqin, 2016). Therefore, reducing the number of bacteria that contaminate sweat on the feet can reduce the foot odor that is caused.

CONCLUSION

Telang flower extract and coffee grounds can be formulated into foot spray to reduce foot odor and have antibacterial activity against *Staphylococcus aureus* bacteria.

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