

Benefits of freeze dried arabica coffee peels (*Coffea arabica*) as an oral antimicrobial Manfaat kulit buah kopi arabika kering beku (*Coffea arabica*) sebagai antimikroba oral

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ABSTRACT

Background: Oral infections are currently treated with synthetic drugs, namely antimicrobials (antibiotics and antifungals) that can cause resistant bacteria, so alternative antimicrobials from herbal groups are needed. Arabica coffee peel contains phytochemical compounds (polyphenols, alkaloids, saponins) which have potential as natural antibacterial. **Purpose:** To examine the benefits of waste of arabica coffee rind in inhibiting growth of *Streptococcus mutans*, *Porphyromonas gingivalis* and *Candida albicans*. **Methods:** This experimental laboratory with the post test only group design was started with making of freeze dried coffee peels 25%, 50% and 75%; positive control used chlorhexidine and nystatin. The antimicrobial test method was performed by the diffusion method and the growth of microbial colonies was calculated using a colony counter. **Result:** Antimicrobial effect increased at all concentration of test solutions to the three microbes. This shows that there is a strong positive relationship between concentration and the number of microbial colonies. The higher concentration of dried arabica coffee peels, the greater the effect of microbial killing power. The biggest effect is on *C.albicans*, *P.gingivalis*, *S.mutans*, consecutively. **Conclusion:** arabica coffee fruit skin can be used as an antimicrobial oral cavity against the growth of *S.mutans*, *P.gingivalis* and *C.albicans*. **Keywords:** peels of arabica coffee, antibacterial, antifungal

ABSTRAK

Latar belakang: Infeksi rongga mulut saat ini diobati dengan obat sintetik, yaitu antimikroba (antibiotik dan antijamur) yang dapat menyebabkan bakteri resisten, sehingga diperlukan antimikroba alternatif dari golongan herbal. Kulit kopi arabika mengandung senyawa fitokimia (polifenol, alkaloid, saponin) yang berpotensi sebagai antibakteri alami. **Tujuan:** Mengetahui manfaat ampas kulit kopi arabika dalam menghambat pertumbuhan *Streptococcus mutans*, *Porphyromonas gingivalis* dan *Candida albicans*. **Metode:** Penelitian eksperimen laboratorium dengan desain *post test only group* ini didahului pembuatan kulit kopi kering beku konsentrasi 25%, 50% dan 75%; kontrol positif menggunakan klorheksidin dan nistatin. Pengujian antimikroba dilakukan dengan metode difusi dan pertumbuhan koloni mikroba dihitung dengan menggunakan *colony counter*. **Hasil:** Efek antimikroba meningkat pada semua konsentrasi larutan uji terhadap ketiga mikroba. Hal ini menunjukkan bahwa terdapat hubungan positif yang kuat antara konsentrasi dan jumlah koloni mikroba. Semakin tinggi konsentrasi kulit kopi arabika kering, semakin besar efek daya bunuh mikroba. Efek terbesar berturut-turut *C.albicans*, *P.gingivalis* dan *S.mutans*. **Simpulan:** Kulit buah kopi arabika dapat dimanfaatkan sebagai antimikroba oral terhadap pertumbuhan *S.mutans*, *P.gingivalis* dan *C.albicans*. **Kata kunci:** kulit buah kopi arabika, antibakteri, antijamur

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INTRODUCTION

Dental and mouth infections are common in the community, the prevalence according to Riskesdas in 2018 is still 57.6%. Infections that often occur are dental caries,¹ periodontal tissue damage (periodontitis, gingivitis) and candidiasis, while the main causes are *Streptococcus mutans* (*S.mutans*), *Porphyromonas gingivalis* (*P.gingivalis*) and *Candida albicans* (*C.albicans*). *S.mutans* are gram-positive bacteria, the main cause of dental caries,² *P.gingivalis* bacteria are gram-negative bacteria that are always associated with causes of periodontal tissue damage, especially gingivitis, while *C.albicans* is a normal fungus of the oral cavity often referred to as the main cause of oral cavity candidiasis³

One way to cope with infections from microbes by reducing the number of microorganisms in the oral cavity, is currently mostly done by using mouthwash

that is bacteriostatic or bactericidal from synthetic ingredients.^{4,5,7} Synthesized mouthwash can cause side effects such as irritation and dry mouth if used for a long time and also occurs bacterial resistance,⁸ so many researchers are looking for alternative mouthwash ingredients that are based on natural or herbal.

One of the ingredients that has been studied about antimicrobials is arabica coffee fruit (*Coffea arabica*), which can inhibit the growth of *S.mutans*, *P.gingivalis* and *C.albicans* because it has a composition of polyphenol compounds, alkaloids, saponins, beta-carotene, vitamin C.⁶ The peel of coffee fruit also contains almost the same compound as coffee fruit, but its utilization in the health sector is still not optimal. At present coffee peels waste in general is only used as raw material for animal feed and raw materials for tea drinks. Therefore this study aims to examine the benefits of arabica

coffee skin waste in inhibiting the growth of *S.mutans*, *P.gingivalis* and *C.albicans* so that it can function as an antimicrobial oral cavity.

METHODS

This experimental laboratory with the post test only group design is principally giving freeze dried coffee powder peel in solution form to *S.mutans*, *P.gingivalis* and *C.albicans* in jelly culture media. After this stage, it can be seen and counted the amount of microbial growth from each dose of the dried arabica coffee peels (*freeze dried*) compared with chlorhexidine and nystatin as positive control and aquadest as negative control.

The research phase is the manufacture of dried arabica coffee fruit peel powder (*freeze dried*), making culture media *blood heart infusion-broth* (BHI-B) and media *blood heart infusion-agar* (BHI-A) and antimicrobial tests on cultures of *S.mutans*, *P.gingivalis* and *C.albicans*. The treatment stage is the manufacture of a sample suspension consisting of positive control using *chlorhexidine* and *nystatin* while negative control using sterile aquadest. Arabica coffee peel (*freeze dried*) is processed into a test solution with various concentrations (75%, 50%, 25%). Then, inoculation of sample suspension on BHI-A media by pouring 25 mL BHI-A media in sterile and marked-petridish. After being cold and solid, a sample suspension is added with various concentrations, positive control and negative control of 0.5 mL in the media using a micropipette and homogeneous using a vibrator, then petridish is put in an incubator at 37°C for 24 hours. The growth of the number of colonies in each petridish was observed and calculated the by using a *colony counter*.

RESULT

The results of anti-microbial test of freeze dried coffee peels on the growth of *S.mutans*, *P.gingivalis* and *C.albicans* have positive values. This means that the greater the concentration of the suspension of the test solution, the average number of colonies of microbes that live is getting smaller (Table 1).

The antimicrobial effect was increased by 25%, 50% and 75%, respectively, in *S.mutans*, *P.gingivalis* and *C.albicans*. This shows a strong positive relationship between the value of concentration and the number of living microbial colonies. The higher the concentra-

tion of dried arabica coffee peels, the greater the effect of microbial killing power.

DISCUSSION

This study used arabica coffee peels as a trial material which is made in powder-form by drying. The basis of the study was the administration of arabica coffee powder (*freeze dried*) on *S.mutans*, *P.gingivalis* and *C.albicans* in BHI-A media can inhibit microbial growth. The inhibition of growth is shown by the reduction in the number of living microbial colonies on BHI-A media. This method makes the trial material able to diffuse and contact optimally with microbial growth in BHI-A media. This study used three types of microbes, namely *S.mutans* Gram positive and Gram negative *P.gingivalis* and *C.albicans*, which are microbes that cause infection in the oral cavity.

In Table 1, observations of antimicrobial tests on aquadest as a negative control did not show an antimicrobial effect on the growth of *S.mutans* bacteria; this is indicated by the number of bacterial colonies growing on BHI-A media. In contrast, positive control with chlorhexidine and nystatin has an antimicrobial effect, characterized by the decreasing number of living *S.mutans* and *P.gingivalis* bacterial colonies. The freeze dried arabica coffee peel test solution 25% has shown an antimicrobial effect on *S.mutans*, *P.gingivalis* and *C.albicans*; antimicrobial effects increased at concentrations of 50% and 75%. This shows that the peel of arabica coffee has an antimicrobial effect on *S.mutans*, *P.gingivalis* and *C.albicans*, but in this study the antimicrobial effect appears to be stronger against *C.albicans* compared with *P.gingivalis* and *S.mutans*.

The results showed that the antimicrobial effect increased at 25%, 50% and 75% of the test solution concentrations, respectively, on *S.mutans*, *P.gingivalis* and *C.albicans*. This point shows that there is a strong positive relationship between the concentration and growth of microbes. The higher the concentration of dried arabica coffee peels, the less the number of microbial colonies that grow. That means, the solution of dried arabica coffee peel has an antimicrobial effect against *S.mutans*, *P.gingivalis* and *C.albicans* bacteria in the order of the strongest antimicrobial power against *C.albicans*, *P.gingivalis* and *S.mutans*, while the order of antimicrobial strength in the concentration test solution is 75%,

Table 1 The results of the calculation of the average number of living colonies of bacteria *S.mutans*, *P.gingivalis* and *C.albicans*

Test group	n	<i>S.Mutans</i> (X±SD)	<i>P.gingivalis</i> (X±SD)	<i>C.albicans</i> (X±SD)
Control (-)	4	580.99 ± 8.83	226.25 ± 7.32	226.50 ± 6.51
Control (+)	4	2.58 ± 1.25	1.50 ± 1.29	0.00 ± 0.00
Concentration 25%	4	502.33 ± 34.86	102.17 ± 5.97	54.50 ± 7.77
Concentration 50%	4	103.33 ± 13.00	55.91 ± 10.50	32.00 ± 1.41
Concentration 75%	4	60.83 ± 9.17	18.58 ± 0.998	16.00 ± 0.00

n=Number of samples ; (X±SD) = average and standard deviation

50%, 25%.

The freeze dried arabica coffee peel has antimicrobial ability against *S.mutans*, *P.gingivalis* and *C.albicans*; this is due to the presence of active compounds in the dried arabica coffee peels. Active compounds from dried arabica coffee peels that may play a role in inhibiting the growth of microbes are polyphenols, alkaloids, saponins, beta-carotene and vitamin C.^{6,11} Beta-carotene and vitamin C function as antioxidants that can inhibit the formation of free radicals.¹¹ The polyphenols in arabica coffee skins are 1.576-7.273 mg/g, while the polyphenols consist of flavonoid compounds, tannins, plavan-3-ol, catechins, epicatechins, hydroxynic acids, ferulic acids and aldehyde compounds such as caffeine. The most existed polyphenol compound in arabica coffee peel is flavonoids.¹²

Bacteria and fungi have significant differences, which are it's structural, morphological, and species differences, as well as how they reproduce; this can affect the workings or effects of antibacterial or antifungal agents.¹⁸

Flavonoids carry out biological activities by damaging bacterial cell walls due to differences in the nature of the lipid polarity of the constituents of bacterial DNA with alcohol groups from flavonoids, with differences in polarity cause cell walls to become damaged and very permeable which causes flavonoid compounds to enter the nucleus of bacterial cells and cause cell death.^{9,10} Flavonoids as antifungals, work through protein denaturation which results in increased membrane permeability and due to protein denaturation will change the composition of protein components that will cause damage and death of fungal cells.¹⁶

Alkaloids work as an antibacterial by inhibiting the synthesis of bacterial cell walls consisting of peptogly-

cans as the main component of gram-positive and gram-negative bacterial cell walls, the presence of these disorders can increase the permeability of the cell wall or membrane, the presence of membrane permeability disruption causing ion and macromolecular cells escaped which eventually the cell will experience cell damage or death.^{13,17} Alkaloid as an antifungal works by influencing the permeability of cell walls so that the function of cell walls changes in the process of transporting essential compounds that cause metabolic disorders and ultimately cause inhibition of colony growth and even death of fungal cells can occur.¹⁶

Saponin works as an antibacterial by damaging cell walls which can reduce cell wall permeability so that it causes intracellular compounds to leak and causing bacterial cells to be deficient in nutrients which ends in cell death.¹⁴ Saponins as antifungals have a mechanism to disrupt membrane permeability due to complex forms between cell walls, fungi cell enzymes and extracellular proteins, so that the process of transporting the required substances is disrupted and results in the death of fungal cells.^{15,18}

It was concluded that arabica coffee fruit peel is useful as an antimicrobial against *S.mutans*, *P.gingivalis* and *C.albicans*. This is due to the synergism of active compounds found in the peel of arabica coffee such as polyphenols, saponins, alkaloids, beta-carotene and vitamin C.

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