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Penulis : Renny Novi Puspitasari, Handayani Handayani, Ratna Sofaria

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NPP: 20071300

LPPM Universitas Nahdlatul Ulama Surabaya

Website : lppm.unusa.ac.id

Email : lppm@unusa.ac.id

Hotline : 0838.5706.3867

The Effects of Turmeric Infusion and Turmeric Juice (*Curcuma Domestica*) on The Staphylococcus Aureus Growth in Vitro

by HandayaniHandayani

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The Effects of Turmeric Infusion and Turmeric Juice (*Curcuma Domestica*) on The *Staphylococcus Aureus* Growth in Vitro

Handayani, Ratna Sofaria, Renny Novi Puspitasari

Faculty of Medicine, University of Nahdlatul Ulama Surabaya

Correspondent author : dr.renny@unusa.ac.id

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ABSTRACT

Background: Turmeric is a plant that grows in tropical areas and functions as medicine. The chemical compounds contained in turmeric have a role as antioxidants, antimicrobials, anti-cancer, indigestion, smallpox, insect bites. The *curcumin* content in turmeric has antibacterial activity against various types of Gram negative, Gram positive, antiviral and anti-tumor bacteria. Essential oils can be used as antibacterial because they contain hydroxyl and carbonyl functional groups which are phenol derivatives. Flavonoids can interfere with cell wall formation with peptidoglycan *transpeptidase* activity which will break down cell walls and damage cell membranes so that important components such as proteins, nucleic acids, nucleotides will be lysis. *Staphylococcus aureus* bacteria are normal flora on the skin, respiratory tract, and digestive tract of food in humans. These bacteria can cause disease when they reach 1,000,000 or 106 per gram, an amount sufficient to produce the toxin. *S. aureus* bacteria can cause various types of infections ranging from minor skin infections, food poisoning to systemic infections. The aim of our study was to analyze the effects of infusion and turmeric juice (*Curcuma domestica val*) on the growth of bacteria *Staphylococcus aureus* through invitro. **Method:** This study is a laboratory experimental study with the aim of analyzing turmeric infusion (*Curcuma domestica val*) and turmeric juice effect on the growth of *staphylococcus aureus* by invitro. This research was conducted in an integrated laboratory, FK UNUSA. The samples in this study were 4 replications per treatment. The independent variables in this study were turmeric infusion and turmeric juice (with a concentration of 10%, 30%, 50% while the dependent variable in this study was the growth of *Staphylococcus aureus* bacteria. Data analysis used was the one way ANOVA test and Pearson correlation to determine the effect of giving turmeric infusion and turmeric juice on the growth of bacteria *staphylococcus aureus* through invitro. **Result:** The average growth of bacteria in the turmeric infusion in group I (control), 10%, 30% and 50% of turmeric infusion was 4.89 ± 0.4425 log CFU / ml, 3.07 ± 0.61330 log CFU / ml, 2.99 ± 0.63986 log CFU. / ml and 3.02 ± 0.22650 log CFU / ml. The average growth of this bacteria in giving turmeric juice in group I (control), giving 10%, 30% and 50% turmeric infusion was 4.89 ± 0.04425 log CFU / ml, 4.40 ± 0.18355 log CFU / ml, 3.10 ± 0.58926 log CFU / ml and 3.02 ± 0.38206 log CFU / ml. **Conclusion:** In this study, found that there was an effect of giving turmeric infusion and turmeric juice (*Curcuma domestica val*) on *Staphylococcus aureus* growth and there was an effect of giving multilevel doses of turmeric infusion and turmeric juice (*Curcuma domestica val*) on *Staphylococcus aureus* growth through invitro.

Introduction

Turmeric is a plant that grows in tropical areas and functions as medicine (Hartati & Balitro, 2013). The chemical content

contained in turmeric is essential oil, fatty oil, curcuminoid compounds, alkaloids, tannins, flavonoids, glycosides and carbohydrates (Gupta et al., 2015). The

chemical compounds contained have a role as antioxidants, antimicrobials, anti-cancer, indigestion, smallpox, insect bites (Hartati & Balitro, 2013). Curcumin in turmeric has antibacterial activity against Gram negative, Gram positive, antiviral and antitumor (Bernawie, 2006). Flavonoids can interfere with the formation of cell walls with peptidoglycan transpeptidase activity which will break down cell walls and damage cell membranes so that important components such as proteins, nucleic acids, nucleotides will lysis (Dewi, 2015).

Staphylococcus bacteria are normal flora on the skin, respiratory tract, and digestive tract of food in humans. These bacteria are also found in the air and the environment (Warsa, 1994). These bacteria can cause disease if it has reached the amount of 1,000,000 or 10⁶ per gram, an amount sufficient to produce toxins (Taylor, 2020). *S. aureus* infection is the common bacterial infections and is the causative agent for a variety of human infections, including infective endocarditis, bacteremia, skin and soft tissue infections, osteomyelitis, septic arthritis, prosthetic device infections, lung infections, gastroenteritis, meningitis, toxic shock syndrome, and urinary tract infections (CDC, 2019).

The purpose of this study was to analyze the effect of infusion and turmeric juice (*Curcuma domestica* val) on the growth of *Staphylococcus aureus* by invitro.

Methods

This research is a laboratory experimental research. The research materials used were turmeric infusion and turmeric juice made from turmeric obtained from turmeric farmers in Pengampon, Setro – Menganti, Gresik. The bacterium used was *Staphylococcus aureus* obtained from

BBLK Surabaya. The media used were nutrient broth and MSA (Manitol Salt Agar).

Making Turmeric Infusion

The preparation of turmeric infusion is by peeling the turmeric, then washing the turmeric using distilled water then grating the turmeric using a grater then adding 100 mL of distilled water to make a concentration of 10%, 30% and 50% treatment then heated to a boil for 15 minutes. After that, the infusion is filtered to separate the simplicia using filter paper.

Test The Effect Of Turmeric Infusion On Staphylococcus Aureus Growth

Each 1 ml of *Staphylococcus aureus* suspension in a nutrient broth with a density of 1.5 x 10⁶ CFU / ml was put into a test tube that had been given 1 ml of turmeric infusion with a concentration of 10%, 30% and 50% then incubated 24 hours at 37°C. After incubation, each mixture was diluted ten times using H₂O, then 0.1 ml of each dilution was planted in (Mannitol Salt Agar (MSA) and then incubated for 24 hours at 37°C, and count the *Staphylococcus aureus* colonies.

The Test of effect of giving turmeric juice on the growth of Staphylococcus aureus

Each 1 ml of *Staphylococcus aureus* suspension in a nutrient broth with a density of 1.5 x 10⁶ CFU / ml was put into a test tube that had been given 1 ml of turmeric juice with a concentration of 10%, 30% and 50%, then incubated 24 hours in a temperature 37° C.

After incubation, each mixture was diluted ten times using H₂O, then 0.1 ml of each dilution was planted in Mannitol Salt Agar (MSA) and incubated for 24 hours at 37°C, then count the *Staphylococcus aureus*

colonies. Number of replications for each group in this study was 4. The study was conducted at the Laboratorium Terpadu FK UNUSA Surabaya in September 2019-March 2020.

Sampling was done using consecutive sampling technique. Inclusion criteria: Staphylococcus aureus bacteria ATCC 25923, Exclusion criteria: Bacteria that do not grow on MSA media.

The variables studied in this study were Staphylococcus aureus growth with the treatment of turmeric infusion and turmeric juice (*Curcuma domestica* val) with a concentration of 10%, 30%, 50%.

All data were tested for normality with the Kolmogorov-Smirnov. If a normal value is obtained, the data analysis technique used to prove the first and second hypotheses is one-way ANOVA with an error rate of 5%. If there is a significant difference, then to determine the difference between treatments, the LSD (Least Significant Difference) test or the Least Significant Difference Test is used. The data analysis technique used to prove the third and fourth hypotheses is Pearson correlation.

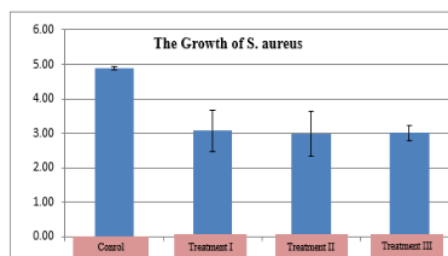
Result

Growth of Staphylococcus aureus with the addition of turmeric infusion

Table 4.1 Staphylococcus aureus growth in log CFU / ml on 10%, 30% and 50% turmeric infusion.

Group	Number of replications	Mean \pm SD colony
Control	4	4.89 \pm 0.4425
Treatment I (infusion 10%)	4	3.07 \pm 0.61330
Treatment II (infusion 30%)	4	2.99 \pm 0.63986
Treatment III (infusion 50%)	4	3.02 \pm 0.22650

From table 4.1, it can be seen that the average growth of bacteria occurred mostly



in group I (control), namely 4.89 log CFU/ml with standard deviation of 0.4425 and the least in treatment group II (30% level), namely 2.99 log CFU / ml with standard deviation of 0.63986.

Figure 4.1 Staphylococcus aureus growth in log CFU / ml on 10%, 30% and 50% turmeric infusion

Based on Figure 4.1, it can be seen that the growth rate of Staphylococcus aureus bacteria was mostly in the control group, while in the treatment groups I, II and III the number of growth tended to be the same.

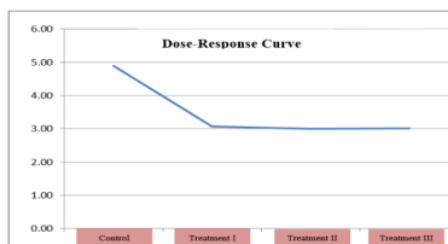


Figure 4.2 dose-response curve of staphylococcus aureus growth with the addition of turmeric infusion

Based on Figure 4.2, the response to the growth of staphylococcus aureus by giving turmeric infusion with levels of 10%, 30% and 50% decreased compared to controls with almost the same number of bacterial colony growths.

Growth of Staphylococcus aureus with the addition of turmeric juice

Table 4.2 Staphylococcus aureus growth in log CFU / ml on 10%, 30% and 50% turmeric juice.

Group	Number of replications	Mean \pm SD Colony
Control	4	4.89 \pm 0.04425

Treatment I (infusion 10%)	4	4.40 ± 0.18355
Treatment II (infusion 30%)	4	3.10 ± 0.58926
Treatment III (infusion 50%)	4	3.02 ± 0.38206

From table 4.2, it can be seen that the average growth of bacteria occurred most frequently in the control group, namely 4.89 log CFU / ml with standard deviation of 0.4425 and the least in the treatment group III which was 3.02 log CFU / ml with standard deviation of 0.38206.

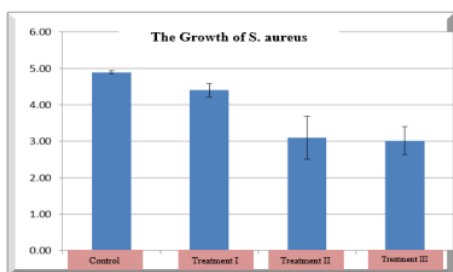


Figure 4.3 Staphylococcus aureus growth in log CFU / ml on turmeric juice with levels of 0%, 10%, 30% and 50%

Based on Figure 4.3, it can be seen that the number of Staphylococcus aureus bacteria growth was mostly in the control group, while the treatment groups II and III tended to be the same.

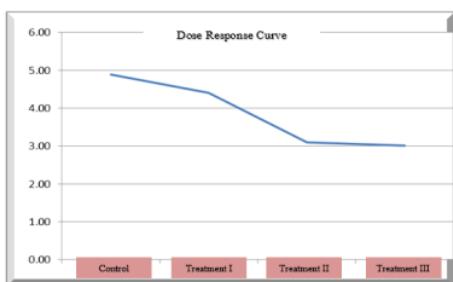


Figure 4.4 Growth dose-response curve of Staphylococcus aureus with the addition of turmeric juice

Based on Figure 4.4, the response on the growth of staphylococcus aureus through giving turmeric juice tended to

Treatment group	Significance
Giving turmeric infusion	.189c
Giving turmeric infusion	.200c,d

decrease at the addition levels; but only slightly decreased in treatment II and III.

Data Analysis

Data Normality test

Table 4.3 Staphylococcus aureus growth normality test by giving turmeric juice infusion

Based on the normality test, the p value of the tested bacteria was given by giving turmeric infusion of 0.189 and giving turmeric juice of 0.200. Both of these p values are greater than 0.05, so it can be concluded that the growth data of staphylococcus with infusion or turmeric juice is normally distributed.

Table 4.4 One Way Anova test on the effect of infusion and turmeric juice on the staphylococcus aureus growth.

Treatment group	Significance
Giving turmeric infusion	.000
Giving turmeric infusion	.000

Based on table 4.4 above, the significance value of the One Way Anova test giving infusion and turmeric juice on the growth of Staphylococcus aureus is 0.000 and 0.000, both of these values are less than 0.05 so that based on this test, there is a significant difference in giving infusion or turmeric juice to the growth of Staphylococcus colonies of aureus.

Table 4.5 Pearson Correlation Test the effect of infusion and turmeric oarding on the Staphylococcus aureus growth

Treatment group	Significance
Giving turmeric infusion	.002
Giving turmeric infusion	.000

Based on table 4.5, it appears that the significance value of turmeric infusion on the growth of staphylococcus aureus colonies is 0.002 and the significance value of giving turmeric juice on the growth of

staphylococcus colonies is 0.000, this value is lower than 0.05, so it can be concluded that there is a significant correlation to the growth of staphylococcus aureus colonies in administration of doses acting on infusion and turmeric juice.

Discussion

The effect of turmeric infusion on the Staphylococcus aureus growth

Based on the results of this research which can be seen in table 4.4, it can be seen that there is a significant difference in the administration of turmeric infusion on the Staphylococcus aureus growth.

Staphylococcus aureus is a gram positive cocci bacteria. Gram positive bacteria have only single plasma membrane surrounded by thick cell wall of the peptidoglycan. Nearly 90% of the cell walls of these gram-positive bacteria are composed of peptidoglycan.

The chemical compounds of turmeric rhizome with water solvents include alkaloids, tannins, flavonoids, glycosides and carbohydrates (Gupta et al., 2015). Flavonoids can interfere with cell wall formation with peptidoglycan transpeptidase activity which will break down cell walls and damage cell membranes so that important components such as proteins, nucleic acids and nucleotides will be lysis (Dewi, 2015). According to Çıkrıkçı et al (2008) curcumin is a phenolic compound that can inhibit bacterial growth by denaturing and damaging cell membranes so that metabolic processes are disrupted.

The infusion process is the process of heating natural ingredients at the temperature of 90°C for 15 minutes with the aim of removing the active substances contained in these ingredients

Table 4.5 shows that there is a significant correlation to the growth of staphylococcus aureus at 10%, 30% and 50% incremental doses of turmeric infusion. Antimicrobials can have a concentration dependent killing, which can kill bacteria based on levels (Katzung, 2007). The higher the level of the antibiotic, the more places it binds to the bacterial cell.

The effect of giving turmeric juice on the Staphylococcus aureus growth

Based on the results, can be seen in the table 4.4, it can be seen that there is a significant difference in giving turmeric juice to the Staphylococcus aureus growth.

Staphylococcus aureus is cocci bacteria which has only a single plasma membrane surrounded by a thick cell wall of peptidoglycan. Nearly 90% of the cell walls of these gram-positive bacteria are composed of peptidoglycan.

One of the active ingredients contained in turmeric is essential oil. essential oil contains 10 sesquiterpenes which are derivatives of certain compounds which are proven to have strong antibacterial activity. Mono terpenes can diffuse into cells and damage the cell membrane structure.

Table 4.5 shows a significant correlation to the growth of Staphylococcus aureus at 10%, 30% and 50% levels of turmeric juice. Antimicrobials can kill bacteria based on levels (Katzung, 2007). The more bacteria that are exposed to high amounts of antimicrobial active substances will increase the effectiveness of the antimicrobial agent.

Conclusion

There is an effect of giving infusion and turmeric juice (*Curcuma domestica val*) on the Staphylococcus aureus growth by invitro and there is an effect of giving

multilevel doses of infusion and turmeric juice (*Curcuma domestica* val) on the *Staphylococcus aureus* growth invitro

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