



Original Research

The effectiveness of garlic, black turmeric, and red betel vine solutions to maintain scalp hygiene (pediculicide efficacy test toward head lice)

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Abstract

Head lice (*Pediculus humanus capitis*) is a parasite sticking on the scalp and in between the hair. It lives by laying its eggs on some strands of hair and sucking blood from the scalp, which results in itching, inflammation, restless sleep, and concentration degradation. Lice could also lower self-esteem. The infection may also lead to anaemia, which affects the learning pattern and cognitive function of children. However, the use of chemical insecticide may have a harmful effect. Therefore, this research tested three natural ingredients, namely garlic, black turmeric, and red betel vine, as the pediculicide. This research was aimed to find safe, natural ingredients to eliminate head lice while maintaining personal hygiene. It was an experimental research with Randomized Posttest Only Control Grup Design. This research's subject was 28 lice, which were grouped into seven treatments with four lice in each group. The seven treatments included the treatment by spraying garlic, black turmeric, and red betel vine solution. The concentration of those natural ingredients was determined at 8% and 16%. The control group was sprayed by using water. The finding showed the significance of black turmeric (p-value 0.000), garlic (p-value 0.000), and red betel vine (p-value 0.001) as the effective pediculicide. The effective concentration as pediculicide was a 16% solution.

INTRODUCTION

Scalp infection is usually caused by head lice or *Pediculus humanus capitis*. Head lice (*pediculus*) is a parasite sticking on the scalp and in between the hair. It lives by laying its eggs on some strands of hair and sucking blood from the scalp, which results in itching, inflammation, restless sleep, and concentration degradation. Lice could also lower self-esteem. The infection may also lead to anaemia, which affects children's learning patterns and cognitive function. ¹

The elimination of *Pediculus humanus capitis* by using chemical insecticide may result in negative effects. The pediculicide sold in the market contains a high chemical element, which may result in allergy and poisoning. One of the natural ingredients potent to be antioxidant and anti-inflammation is banana skin extract.² It is effective and could be planted in our yard. This research was aimed to find out the effectiveness of three natural ingredients to eliminate head lice. They were black

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turmeric (*Curcuma aeruginosa roxb*), garlic dan red betel vine (*Piper crocatum*).

Black turmeric (*Curcuma aeruginosa roxb*) is known to be useful for skin health. It contains beneficial essential oil, curcuminoid, alkaloid, and saponin.³ The essential oil is effective in killing head lice. It is because essential oil has its antibacterial effect, which keeps the scalp from damage. The antibacterial property in black turmeric is mainly contributed by terpene compounds, which are monoterpene and sesquiterpene.⁴

Garlic is effective in killing head lice as it contains ethanol with an 8% concentration. It was proven to be effective in killing head lice within 0.030 hours⁵. Besides, garlic is often used for its antifungal and antibacterial properties. Garlic contains essential oil, allicin, scordinin, and saponin.⁶

Red betel vine extract could also kill head lice as it contains 0.8 – 1.8% essential oil (consists of chavicol, chavibetol (betel phenol), allylprocatechol (hydroxychavikol), allylprocatechol-mono dan diacetate), vitamin c, sugar, cineole, caryophyllene, cadinene, estragole, riboflavin, starch, sesquiterpene, terpene, phenylpropane, tannin, diastase, carotene, p.cymene, thiamine, carvacrol, eugenol and amino acid.⁷

METHODS

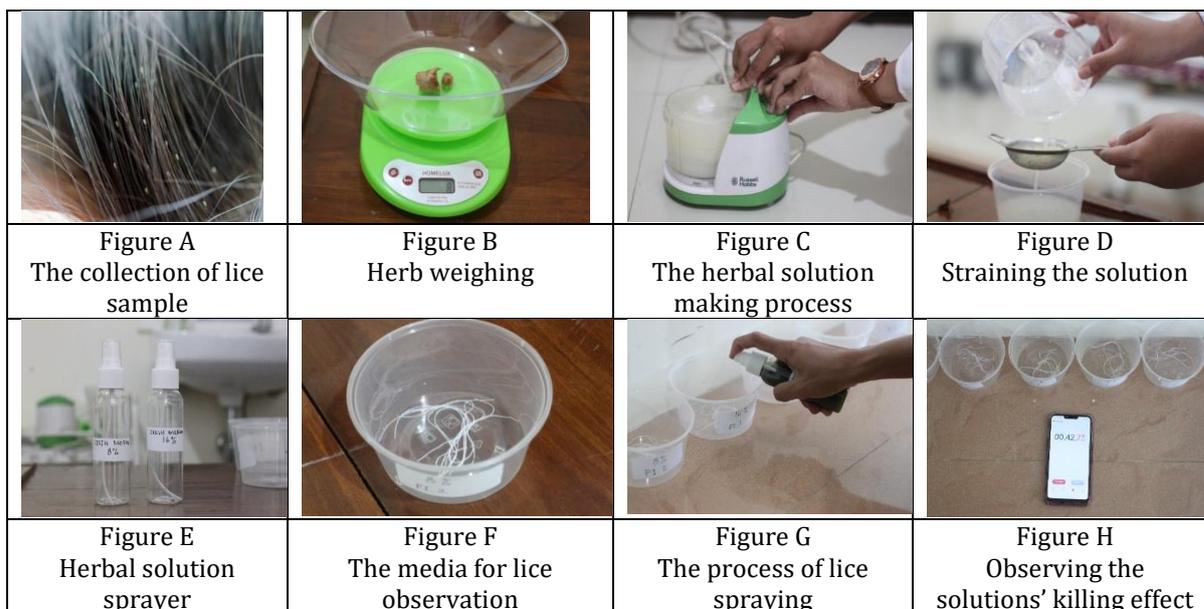
This study consisted of three kinds of research with the same research technique, design, and the number of groups. It was mainly experimental research with Randomized Posttest Only Control Grup Design. The subject of this research was head lice obtained from five female children who lived at Sendangguwo District of Semarang with *Pediculus humanus capitis* infection. The sample used was a group of

adult head lice, with 12 head lice for each research sample. The research group was divided into three groups of treatment, with four head lice for each treatment group. Treatment 1 used herbal spray with a concentration of 8%, treatment 2 used a concentration of 16%, and treatment group 3 used only water. The natural ingredients used were garlic, black turmeric, and red betel vine.

In preparing the solution, garlic, black turmeric, and red betel vine were weighed based on its planned concentration size as presented by figure B. the ingredients were grounded, strained, and mixed with water-based on the demanded concentration, which was 8% and 16% as presented by figure C. the solution was strained by using a strainer (figure D), put into a spray bottle (figure E). the cup and for lice media added with 2g of threads to make present, the similar condition with the real head condition was prepared (figure F).

The treatment was started by experimental animal adaptation. The adaptation was carried out in two hours. Four lice were put into the cup and propped with 2 grams of white threads (figure G). the 10ml sprayer was used to spray the experimental group three times. Meanwhile, the control group was given only a water sprayer.

The research was divided into seven treatment groups. Treatment group 1 (X1) was sprayed using 8% garlic solution, group 2 (X2) was sprayed using 16% garlic solution, group 3 (X3) was sprayed using 8% black turmeric solution, group 4 (X4) using 16% black turmeric solution, group 5 (X5) using 8% red betel vine solution, group 6 (X6) using 16% red betel vine solution, and group 7 (X7) using only water. The killing effect was measured by using a stopwatch, while the dead lice were observed and noted (figure H).



RESULTS

The total sample of the research was 28 lice from five children (figure A). each group of treatment consisted of four lice put into a cup with 2 grams of thread (figure F). the duration of research was two hours for lice adaptation and 45 minutes for data collection. The research data was in the form of killing the power duration of the herbal solution. It was measured by using a stopwatch for 45 minutes. It was shown that the most effective was the 16% red betel vine solution with a minimum of 4 minutes, a maximum of 6 minutes, and an average of 5 minutes of pediculicide duration. The slowest pediculicide duration was in 8% garlic solution with a minimum of 19 minutes, a maximum of 25 minutes, and an average of 22 minutes, as presented by table 1.

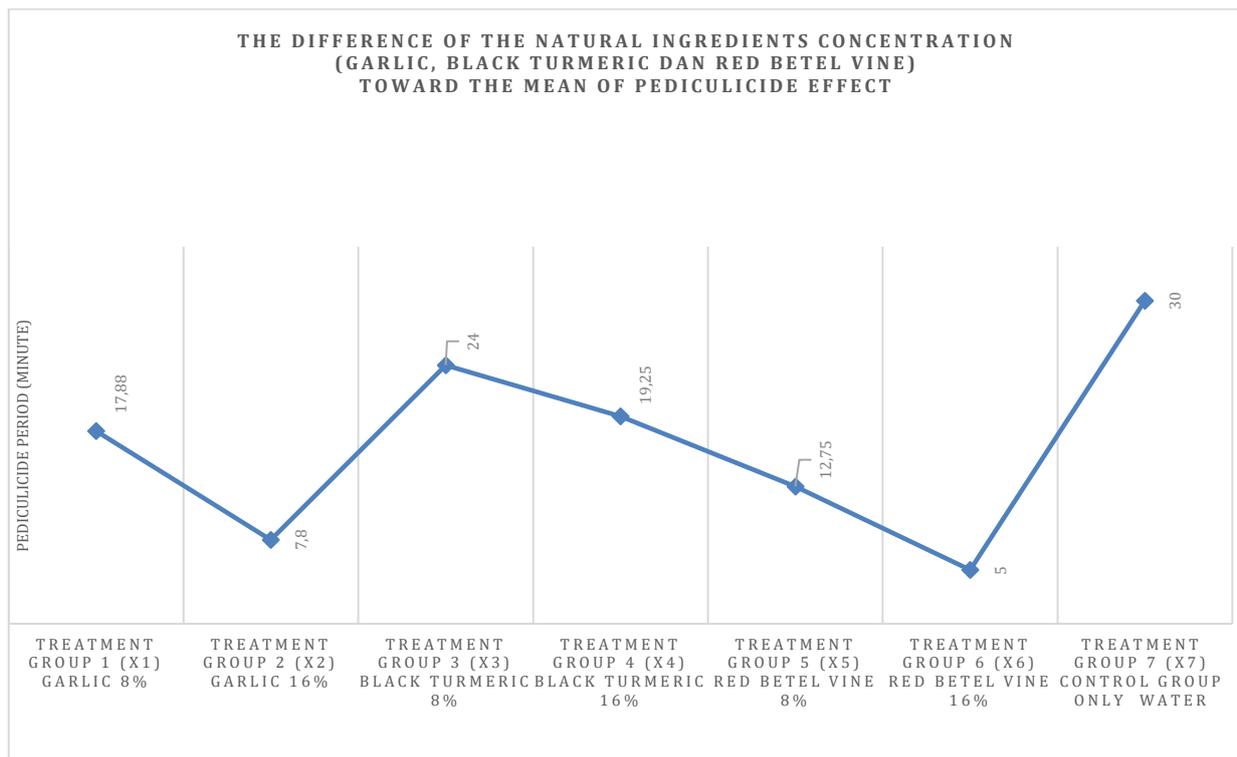
The difference of garlic, black turmeric, and red betel vine concentration toward the mean of pediculicide duration showed that the 16% concentration was more effective than the 8% solution. The most effective pediculicide was 16% red betel vine solution (X6 group), with the mean of pediculicide was 5 minutes. On the other hand, the least effective pediculicide was 8% black turmeric (X3 group), with the

mean of pediculicide was 24 minutes, as presented by graphic 1.

The statistical data analysis was implemented for each herbal solution and the control group. The statistical test used was from the Mann-Whitney test or Kruskal-Wallis test. The correlation between the implementation of garlic solution with the shown pediculicidal effect was p-value = 0.000. It means that the garlic solution spraying was significant to the pediculicide period. The correlation between the implementation of black turmeric solution with the shown pediculicidal effect was p-value = 0.000. It means that the black turmeric solution spraying was significant to the pediculicide period. The correlation between the red betel vine solution's implementation with the shown pediculicidal effect was p-value = 0.001. it means that the red betel vine solution spraying was significant to the pediculicide period. The three mentioned natural ingredients were significant to kill lice. In other words, the three natural ingredients were potential natural insecticide to eliminate head lice.

Table 1
the pediculicide duration based on the garlic, black turmeric, and red betel vine solutions' concentration.

Groups	pediculicide duration (minute)		
	minimum	maximum	mean
Treatment group 1 (X1) garlic 8%	19	25	22
Treatment group 2 (X2) garlic 16%	13	15	13.75
Treatment group 3 (X3) black turmeric 8%	23	25	24
Treatment group 4 (X4) black turmeric 16%	19	20	19.25
Treatment group 5 (X5) red betel vine 8%	10	15	12.75
Treatment group 6 (X6) red betel vine 16%	4	6	5
Treatment group 7 (X7) control group only water	30	30	30



Graphic 1

The difference of the natural ingredients (garlic, black turmeric, and red betel vine) concentration toward the mean of pediculicide duration

DISCUSSION

Spraying 16% black turmeric solution (X4 group) resulted in an average of 19.25 minutes of pediculicide effect. The black turmeric solution is significant toward the pediculicide effect with a p-value 0.000. Based on the analysis, the low concentration of black turmeric resulted in a bacteriostatic effect and bactericidal effect in high concentrations. This research proved that 16% black turmeric solution (X4 group) was more effective than the 8% black turmeric (X3 group). It was supported by

another research that stated that the higher the black turmeric concentration, the higher the active antimicrobial element in it, the higher ability to prevent microbial development. The low concentration black turmeric could perform as bacteriostatic, and the high concentration black turmeric could perform as bactericidal. The antibacterial property is contributed by terpenoid compounds in the form of monoterpene and sesquiterpene, which are the main components of black turmeric. The terpene compounds in black turmeric are the result of the secondary metabolism of

the plant, which is useful to avoid microbe (Bobarala, 2012). Black turmeric also contains essential oil, which helps prevent the growth of *S. aureus* and *B. subtilis* in certain concentrations.^{8,9}

The mean of the group's pediculicide effect, with a 16% garlic solution (X2 group), was 13.75 minutes. The garlic spray was significant, with a p-value of 0.000. It was in line with research mentioned that 4% garlic solution could kill lice in 0.4450 hours, 6% garlic solution could kill lice in 0.1380 hours, and 8% garlic solution could be an effective insecticide for head lice as mentioned that the higher solution of garlic was the better able to kill head lice or pediculosis capitis.⁵ Another researcher also stated that garlic extract is mortal for plant lice (*M. persicae*). In that research, the 0% garlic solution (control group) could kill 34.67% plant lice, 45% garlic solution killed 54.00% lice, and 60% garlic solution killed 72.33%^{10,11}. The chemical compounds in garlic such as allicin, saponin, and flavonoid are believed to perform as an insecticide for head lice, safe for health and the environment.⁵

In this research, the treatment group 7 (X7) as the control group was only receiving water spray. The mean of the pediculicide effect was 30 minutes. This research was supported by other researches that if the control group didn't receive any treatment, the pediculicide effect was performed in 8.974 hours. It was because head lice could live for ten days at 5°C without any blood intake and died at 40°C⁸. Head lice could not live without blood intake in 15-20 hours.¹² Head lice need a warm and humid climate for their incubation period. Meanwhile, for reproduction, they need an optimum temperature of 28°C - 32°C. Another research stated that pediculosis capitis could stay alive for 1-2 days out of the human head. The eggs could stay for a week outside the human head⁸. The long lifespan of pediculosis capitis, either with or without blood intake, could boost lice growth. The rapid growth and the effect of lice bite result

in the itching, which stimulates scratching to eliminate the itching. The itching as the effect of lice's saliva and excretion which is absorbed by the scalp.^{9,13,14}

The treatment by using garlic is not only killing the lice but also reducing the itching and inflammation in the head. It was supported by research that garlic contains a chemical compound in its essential oil has antibacterial and antiseptic property.⁶ The essential oil in garlic could also perform antifungal property to prevent candida Albicans growth.¹⁵ The other chemical compounds in garlic, which are allicin, have a strong aroma, which is powerful to damage disease germ protein. The active element in allicin is assumed to have a powerful antibiotic function.^{6,16,17}

The treatment using red betel vine in this research proved that the 8% red betel vine solution (X5 group) killed the lice in 12.75 minutes, and 16% red betel vine solution (X6 group) could kill in five minutes. The red betel vine solution was significant to kill head lice with a p-value 0.001. This research was in line with the previous research using different concentrations of red betel vine solution for *Sitophilus oryzae*'s mortality. The higher concentration of red betel vine extract, the higher *Sitophilus oryzae*'s mortality. The higher concentration of the essential oil resulted in a higher aromatic effect which is avoided by insects.¹⁸ The higher concentration also increases the poisoning effect for an insect, which could inhibit the growth and kill the insect.¹⁴

The compound in red betel vine, which is lethal for lice, is tannin. Tannin acts as contact and stomach poison for the insect. The mechanism is when lice had direct contact with the solution, the tannin-containing poison absorbed by the wall of the lice body and slowly kill the lice. Tannin functions as the protection inside or outside the body tissue. Besides, tannin could also shrink the tissue and close the protein on the skin and mucosa structure. Meanwhile, the tannin in red betel vine could kill lice.

Besides, tannin could also act as a stomach poison. The nutrition intake in lice's body could not be digested as it is intervened by tannin from the red betel vine directly sprayed on the lice. Indigestion in lice leads to death.^{15,18}

Besides tannin, red betel vine also contains phenolic compounds which could kill *Pediculus humanus capitis*. Phenol is an active compound that could initiate typical biological activity such as toxicity to inhibit nutrition, act as an ant parasite, and pesticide. Therefore, the phenolic compound in red betel vine could kill results in death in *Pediculus humanus capitis*.^{15,19}

Red betel vine also contains alkaloids, which could act as a stomach poison in insects and lead to death. Alkaloid decreases and damages the cell's membrane. This way, alkaloids could infiltrate and poison *Pediculus humanus capitis*. Death is mainly caused by indigestion.²⁰

The effectiveness of red betel vine solution to kill *Pediculus humanus capitis* was represented by the pediculicide effect shown by the certain herbal concentration. The 16% herbal concentration showed a quicker pediculicide effect compared to the 8% herbal concentration. The other proof of effectiveness could also be presented by the difference of *Pediculus humanus capitis* condition when it was sprayed by using red betel vine solution and that one sprayed by using only water. The success in using red betel vine could be beneficial for the people as they could get natural insecticide to inhibit *Pediculus humanus capitis* growth and avoid the use of chemical insecticide to eliminate *Pediculus humanus capitis*.

CONCLUSION

The three natural ingredient solutions were significant to kill head lice (*Pediculus humanus capitis*). They were black turmeric (p-value 0.000), garlic (p-value 0.000) and red betel vine (p-value 0.001). The effective concentration as pediculicide was 16%.

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The use of natural ingredients black turmeric, garlic, and red betel vine to eliminate head lice (*Pediculus humanus capitis*) was safer. The natural ingredients are easy to get and could result in harmful side effects. The effective solution was the solution with a 16% concentration.

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CONFLICTS OF INTEREST

Neither of the authors has any conflicts of interest that would bias the findings presented here.

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