The Effectiveness of Garlic Extract (*Allium Sativum L.*) and Citronella (*Cymbopogon nardus L*) as Insecticides Againts *Pediculus humanus capitis*

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Abstract. Head lice *Pediculus humanus capitis* are parasites that live on the scalp. Garlic and citronella are plants that can be used as natural insecticides. *Allium sativum* L. (garlic) contains metabolites of the flavonoid class, saponins, and allicin which have toxic properties to insects so they can be used as natural insecticides. Citronella extract (*Cymbopogon nardus L.*) apart from providing a fragrant aroma, can also be a cause of death for head lice. This study aims to determine the time of death and differences in mortality time of *Pediculus humanus capitis* after administration of natural insecticides. The research method used is experimentation with a purposive sampling. The data were analyzed using the Kruskal-Wallis test. The population is head lice with a sample of 125 individuals with 5 repetitions. The result is a difference in the mortality time of *Pediculus humanus capitis* after administration of natural insecticides. An average mortality value of garlic extract takes 4 minutes 35 seconds, citronella extract takes 3 minutes 34 seconds and the combination of garlic and citronella extract takes 1 minute 58 seconds. This study concluded that the combination of garlic and citronella extract 25% required the fastest time to kill head lice, namely 1 minute 58 seconds.

Keywords: Human head lice, natural insecticide, garlic, citronella.

1. Introduction

Head lice infestation can occur in developed or developing countries and girls are usually more affected, perhaps because girls usually have long hair [1]. The prevalence of Pediculosis capitis in America is around 3,661.4%, Africa 58.9%, Australia 13%, Europe 0.48-22.4%, England 37.4%, Turkey 0.7–59% and epidemiological data on *Pediculosis capitis* infestation still lacking [2].

Even though according to epidemiological data, pediculosis infestation in Indonesia is still low, Prof. Ir. Ahmad Sulaeman, MS, PhD, IPB professor in an interview with GridHEALTH.id (2019) said, "Almost all people in Indonesia experience lice, this is

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because there is a habit of looking for lice which is often done by Indonesian people and is usually done by woman".

Human head lice, natural insecticide, garlic, citronella Head lice *Pediculus humanus capitis* are parasites that live on the scalp, causing the scalp to become itchy. People throughout the world have definitely been infected with head lice, most often occurring in children who are still at school. This can occur due to contact with the head of another person who has lice, due to not washing their hair or being infected from animal. Symptoms of a head lice infection will definitely feel itchy on the scalp and can usually spread to the neck or ear area. The itching feeling tickles like there is a small animal walking on the scalp. Sucking blood on the scalp is the lice's way of surviving and this is what causes hair to become damaged, and their saliva is what causes itching [3].

Botanical insecticides or vegetable pesticides are insecticides that come from plants. Plants have secondary metabolites (chemical compounds) in the form of crystals, starch, etc. which can protect against insect damage and potential pathogens. According to Julianto, 2020, many plants in Indonesia contain secondary metabolites which have insecticidal functions, namely tannins, alkaloids, flavonoids, cyanides, steroids, saponins and essential oils [4].

Allium sativum L. (garlic) contains flavonoid, saponin and allicin metabolites which have toxic properties for insects so they can be used as natural insecticides, which is very effective as a head lice killer. The results of administering garlic extract to head lice *Pediculus humanus capitis* at the highest concentration of 8% took 0.0630 hours to kill the lice, a 6% concentration took 0.1380 hours and the lowest concentration of 4% took 0.4450 hours. . The higher the concentration, the more effective it is as an insecticide against *Pediculus humanus capitis* [5].

The sulfur compounds in garlic can suffocate ticks by blocking their respiratory systems, leading to their death. Garlic extract can also disrupt the tick's nervous system, causing paralysis and death. Citronella oil has been found to have insect-repelling properties and is used in candles, sprays, and lotions to repel mosquitoes and other insects. However, there is limited information on the effectiveness of citronella oil against head lice. One study found that citronella oil was effective as a repellent against head lice for up to 24 hours. The exact mechanism of action of citronella oil against head lice is not well understood, but it is believed that the strong odor of citronella oil may repel or suffocate the lice. Further research is needed to determine the effectiveness of citronella oil as an insecticide against head lice [6].

Citronella oil is classified into two chemotypes: Ceylon type and Java type. The Ceylon type is obtained from *Cymbopogon nardus* Rendle and contains citronellal (5–15%), geraniol (18–20%), geranyl acetate (2%), citronellol (6–8%), limonene (9–11%), and methyl isoeugenol (7–11%). The Java type is obtained from Cymbopogon winterianus Jowitt and contains citronellal (35–45%), geraniol (20–30%), and citronellol (3–8%) [7].

Citronella (*Cymbopogon nardus L.*) is a natural ingredient used for alternative therapy for Pediculus humanus capitis. The citronellal content in citronella extract apart from providing a fragrant aroma, can also cause the death of head lice due to continuous loss of fluid or desiccant, and can also reduce itching on the skin [8].

The theory behind citronella oil as an insecticide is that the strong odor of the oil can repel or suffocate insects. The oil contains compounds such as citronellal, geraniol, and limonene that are known to have insect-repelling properties. When applied to the skin or clothing, the strong odor of citronella oil can mask the scent of the host and make it difficult for insects to locate and feed on the host. In addition, the oil may suffocate insects by clogging their respiratory system, leading to their death. However, further research is needed to determine the exact mechanism of action of citronella oil against head lice [9].

Based on the description above, the author is interested in testing the effectiveness of the combination of garlic extract and citronella on *Pediculus humanus capitis* with the title "Testing the effectiveness of garlic extract (*Allium sativum L.*) and Citronella (*Cymbopogon nardus L.*) as an insecticide against *Pediculus humanus capitis* ."

2. Method

The research method used is an experimental method with the Post Test Only Control Group Design method. Experimental research is research that carries out experimental activities, which aims to determine the effects that arise as a result of certain treatments or experiments [10]. The population in this study was head lice with a sample of 125 individuals with 5 repetitions and each plate contained 5 individuals in 5 treatment groups, namely 2 treatments as positive and negative controls, 25% garlic extract treatment group, 25% citronella treatment group, and groups treated with a combination of 25% garlic extract and citronella extract.

Data was obtained based on the length of time it took for head lice to die after being given natural insecticides, namely garlic and citronella extracts.

The data analysis technique is carried out by carrying out a normality test using the Shapiro-Wilk. then continued by Kruskall-wallis test.

3. Results

Based on the results of research on garlic extract, citronella extract and a combination of garlic extract and citronella as an insecticide against head lice, it shows different times of death for lice. The average result of five repetitions and there were 5 fleas on each plate, namely the average value for garlic extract was 4 minutes 35 seconds, citronella extract 3 minutes 34 seconds and a combination of garlic and citronella extract 1 minute 58 seconds.

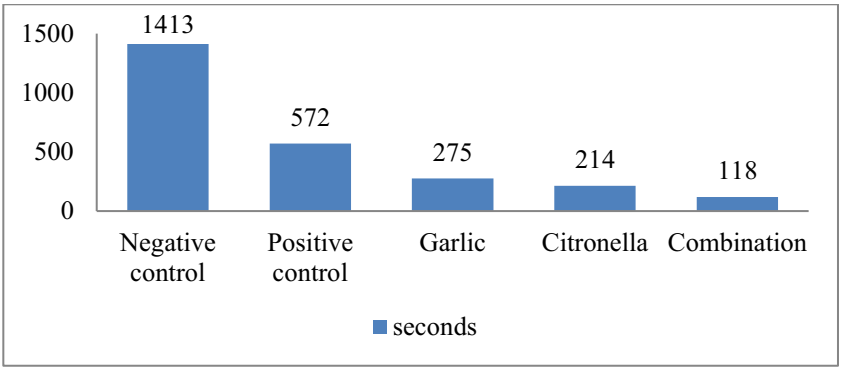

Fig. 1. Graph of effectiveness test results for garlic extract, citronella extract and a combination of extracts

From the results of the graph it can be seen that the average death time for head lice, it can be concluded that the combination of garlic extract and citronella with a concentration of 25% is more effective as an insecticide against head lice because it requires a faster killing time compared to other groups such as garlic and citronella extract.

Based on the results of the normality test, there was one data that was not normally distributed, namely garlic extract with a sig value. 0.012. Because of the three data tested, one of the data was not normally distributed, it was continued using the Kruskal-Wallis test.

Table 1. Data Analysis Kruskal-Wallis test.

Test Statistics	
	Time (seconds)
Kruskal-Wallis H	62,189
df	2
Sig.	<.001

The Kruskal Wallis test, the sig value was obtained. of 0.001, where this value is smaller than the limit value, namely 0.05. It can be concluded that there is a difference in the mortality time of *Pediculus humanus capitis* after administering natural insecticides (25% garlic extract, 25% citronella extract and a combination of 25% garlic and citronella extract).

4. Discussion

This research is experimental in nature and aims to determine the time of death of *Pediculus humanus capitis* after administering natural insecticides, with the method used being The Post Test Only Control Group Design, namely observing *Pediculus humanus capitis* after treatment. In this research, it begins with making garlic and citronella simplicia, followed by making garlic and citronella extract extracts and making garlic and citronella extract concentrates, then collecting head lice. In this research, the head lice used according to the criteria are mature head lice, and did not receive anti-lice treatment for at least one month. The sample is collected from Asyiddiqiyyah elementary school students.

This research was carried out in the Parasitology laboratory. Before carrying out the examination, head lice were kept in 5 petri dishes each, and then examined by dripping 0.05 ml of extract on each head louse. The next step is recording the time of death of the head lice with signs that the lice are not moving or not moving and carrying out the Kruskal-wallis test.

Garlic (*Allium sativum*) and citronella (*Cymbopogon nardus L.*) contain alkaloid and citronella compounds which can kill head lice. This is proven by research that has been carried out, which shows that the death of head lice (P. humanus capitis) is caused by the administration of garlic extract, citronella extract and a combination of garlic and citronella extracts at a concentration of 25% each.

Based on the research results, data was obtained showing that in the 25% concentration garlic extract treatment group, the kill time was an average of 4 minutes 35 seconds. For the 25% citronella extract treatment group, the average kill time was 3 minutes 34 seconds. And for the treatment group, a combination of 25% garlic extract and citronella produced an average kill time of 1 minute 58 seconds. From the three treatment groups, it can be seen that the treatment group with a combination of 25% garlic extract and citronella produced the fastest kill time compared to the other treatment groups.

The concentration of garlic and citronella extract treatment affected the mortality rate of head lice. The greater the content of metabolite compounds, the greater the mortality rate of head lice. In this study the concentration used was 25%. This is in line with research conducted by Susanty (2020), garlic extract as an insecticide against head lice (Pediculus humnus capitis) with concentrations of 25%, 50%, 75% and 100%. Based on the results of statistical tests carried out, there were differences in *Pediculus humanus capitis* mortality with concentrations of 25%, 50%, 75% and 100%. The higher the concentration, the more effective it is as an insecticide against *Pediculus humanus capitis* [11].

Onions have antibacterial properties which are useful in getting rid of scalp infections and parasites. Premature graying of hair is caused by natural antioxidants that reduce catalase; onions help control this problem by increasing catalase. Onion juice can help with hair growth, prevent hair loss and accelerate the growth of new hair. Additionally, onion juice can be used to prevent gray hair and also works on other hair problems such as dandruff,

and fungal infections. Apart from that, citronella extract can cause death to insects, because it is a contact poison which causes disturbances in the insect's central nervous system [12].

Garlic extract can kill *Pediculus humanus capitis* head lice by disrupting the insect's nervous system and making it uncomfortable so that the insect will die. The active sulfur compounds contained in garlic are effective in naturally eliminating pests. Several studies show that garlic extract has insecticidal properties that can kill insects, including head lice. One study showed that a 5% concentration of garlic extract was effective in killing head lice [13].

The working process of garlic extract in killing head lice is as follows: The active sulfur compounds in garlic disrupt the nervous system of head lice, the active sulfur compound makes head lice uncomfortable and makes them die, and 5% concentration of garlic extract is effective in killing head lice. In the same study, a combination of 5% concentration of garlic extract and 5% concentration of apple cider vinegar was more effective in killing head lice. However, more research is being done on garlic extract as an insecticide for head lice. In this study, head lice were treated with garlic extract and citronella extract which resulted in the head lice dying due to direct contact between the head lice and the garlic and citronella extract. The high mortality rate for head lice is due to the content of garlic and citronella extracts which can release the chitin layer that makes up insect cuticles [14].

The research results show that garlic (*Allium sativum*) and citronella (*Cymbopogon nardus L.*) extracts can be used as natural insecticides. Because garlic extract and citronella extract showed a fairly high mortality rate for head lice compared to the positive control used.

5. Conclusion

From the results of the research carried out, it was concluded that the time of death of *Pediculus humanus capitis* after administering natural insecticides (25% garlic extract, 25% citronella extract and a combination of 25% garlic and fragrant citronella extract), namely 4 minutes 35 seconds for garlic extract, extract citronella 3 minutes 34 seconds and a combination of garlic extract and citronella 1 minute 58 seconds. And there was a difference in the mortality time of *Pediculus humanus capitis* after administration of natural insecticides (25% garlic extract, 25% citronella extract and a combination of 25% garlic and citronella extract) based on statistical tests using Kruskal-Wallis.

Authors Contributions. Oktafirani Al Sas carried out the parasitology studies, participated in the analysis the effectiveness, participated in its design and coordination. Pipin Supenah helped to draft the manuscript. Hery Prambudi participated in performed statystics analysys. All authors read and approved the final manuscript.

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